THE

AMERICAN NATURALIST.

VOL. XII. — *MAY*, 1878. — No. 5.

HAIRS AND GLANDULAR HAIRS OF PLANTS, THEIR FORMS AND USES.

BY PROF. W. J. BEAL.

COMMON in green-houses is a plant called *Ageratum mexicanum*, which is grown chiefly for its light-blue heads of flowers which are valuable for bouquets. The stems and framework of the leaves are slightly rough on account of large numbers of hair-like projections along the entire surface. A small fragment placed under a moderate magnifying power reveals the structure of these beautiful and delicate objects as follows:

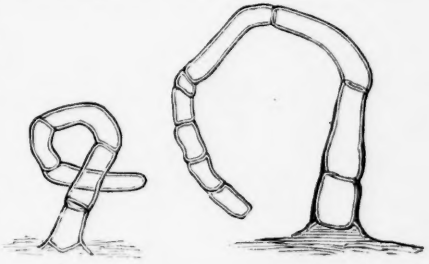

FIG. 2. FIG. 1.

Curved hairs on *Ageratum mexicanum*.[1]

The greater number of these consists of from five to twenty cells of different sizes and lengths placed end to end. Each hair or chain of cells is curved more or less, often into a complete ring, always towards the top of the plant. The end cell is blunt or rounded at the tip. Scattered among these are occasionally seen sharp-pointed hairs which are straight and much more slender. Still less frequently may be seen larger and stouter projections, like Fig. 4, in which there are two rows of

[1] The degree to which these figures are magnified is not given because of considerable uncertainty in most cases. The objects were all drawn by Mr. W. S. Holdsworth, a student in Michigan Agricultural College, generally without the use of a camera. A Wales one-fifth objective, and a B eye-piece were the highest powers used in any case.

cells overlapping each other. The lower cells are three or four times as long as broad, while towards the top the transverse diameter is the greater. The top of the projection is capped with a single hemispherical cell which is filled with a mucilaginous substance. All the other cells are in a greater or less degree transparent. They are filled with a liquid containing granules which under a magnifying power of 250 diameters are often seen to move about in steady flowing currents. Some of these glandular hairs, like Fig. 5, have but a single row of cells for the main portion of their length. Perhaps still other

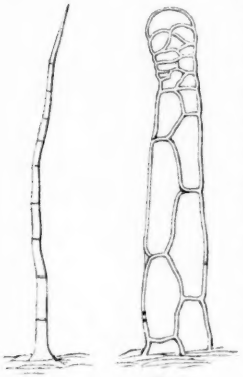

FIG. 3. FIG. 4.

FIG. 3. — Slender hair of *Ageratum mexicanum*.
FIG. 4. — Glandular hairs having two rows of cells.

FIG. 5.
Hair of *Ageratum*.

FIG. 6.
Hair of *Erigeron canadense*.

FIG. 7.
Stout one-celled hair on *Panicum capillare*.

forms might be found which would be intermediate between some of these, showing more conclusively that they were modified forms of the same members.

Erigeron canadense, a common weed often known as horse-weed or mare's tail, is clothed all over its surface with slender rapidly

tapering hairs composed of a single row of cells. Many species of *Helianthus* are covered with similar hairs. The surface of *Panicum capillare*, old witch grass, is covered with slender, one-celled hairs which are straight and quite stiff for their size. The surface of a common *Physalis*, or ground cherry, abounds in slender hairs composed of from ten to fifteen cells placed in a single row. Some of these hairs terminate in a sharp point, but most of them have, at the end, a round cell like a knob, full of a sticky substance. Occasionally a hair produces one or more branches which may likewise terminate with a short point or a globular cell.

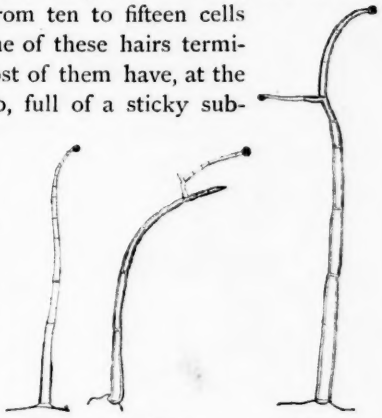

FIG. 8. FIG. 9. FIG. 10.
Hairs on surface of *Physalis*, ground cherry.

The fruit of *Circæa lutetiana*, enchanter's nightshade, is covered with rather stout one-celled hairs which have a hook at the extremity. The stems of the common butter bean of our gardens have a few scattering hairs of similar structure, though they are smaller and much more delicate.

FIG. 11.—Hooked hair on fruit of *Circæa lutetiana*.

The surface of *Malva rotundifolia*, common mallow, is quite harsh to the touch on account of numerous rather stout one-celled hairs, one to six of which project from a conical protuberance. These stout hairs spread in every direction. Among the hairs

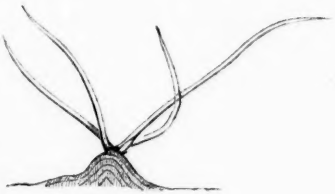

FIG. 12.
Hairs on *Malva rotundifolia*.

FIG. 13.
Sessile gland on same plant.

are a few sessile glands capped with two quarters of spheres.

The edges of the petioles of *Steironema* (*Lysimachia*) *ciliata*, a kind of loosestrife, are fringed with hairs, some of which are short and simple, while others are much larger and irregularly branched, like a stag's horn. Each hair whether simple or branching seems to consist of one cell, made of several pieces fitted together. The surface of *Leersia oryzoides*

FIG. 14.
Hairs on petioles of *Steironema ciliata*.

FIG. 15.—Hairs on *Leersia oryzoides*.

and *L. virginica*, rice-cut grass, is well supplied with short stout one-celled spines, all of which point downwards.

FIG. 16.—Hairs on *Galium*.

Several species of *Galium*, bed straw, are also supplied with hooks of a similar character. In these the base of each hook is quite broad and the point quite short.

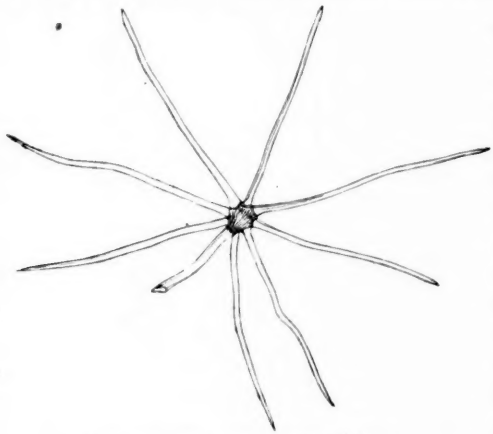

FIG. 17.—Hair on *Aralia papyrifera*.

The under surface of the leaves and the young stems of *Aralia papyrifera*, Chinese rice-paper plant, are thickly covered with a woolly substance which consists of immense numbers of one-celled stalks, each having at the tip six or more one-celled arms or rays which spread in every direction like the spokes of a wheel.

The common mullein is covered in every part with a still more abundant supply of branching hairs. The main axis of the hairs has radiating arms at different heights along its length. The glaucous nature of cabbage leaves and plums is due to numerous small cells on the surface. The mealy substance on pig weed, or lamb's quarter, consists in numerous capitate hairs.

Shepherdia canadensis is a rather rare shrub growing about the borders of lakes and seas. The young stems and buds, and portions of the leaves, are rendered red or rusty on account of the large number of scales, each of which is held to the plant by a short stem. Figs. 18 and 19 show two of

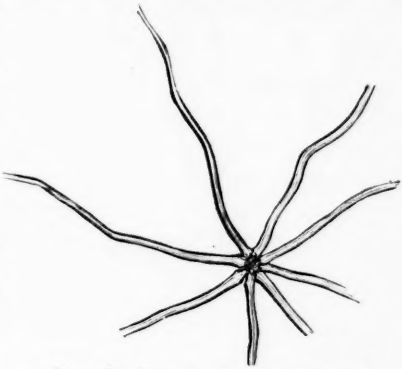

FIG. 18.—Branching hair on *Shepherdia canadensis.*

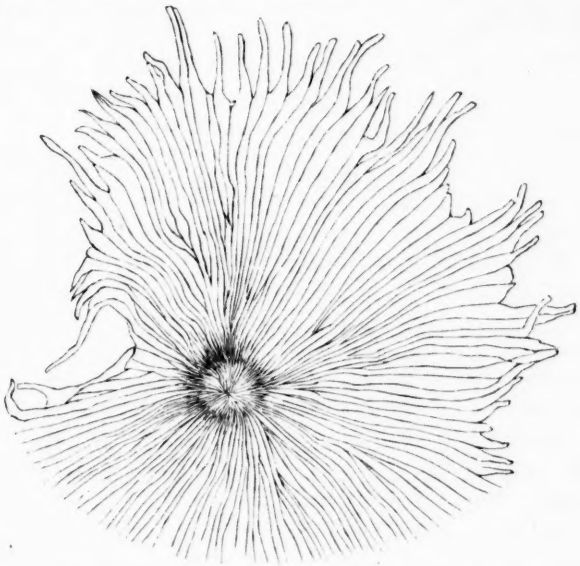

FIG. 19.—Shield-shaped scale on *Shepherdia canadensis.*

these objects. In Fig. 19 there are several rays attached side by

side throughout most of their length, while in Fig, 18 there are but few rays, which separate at once from each other. Between these two extreme specimens are found any number of intermediate forms. Much like the preceding are the star-shaped scales

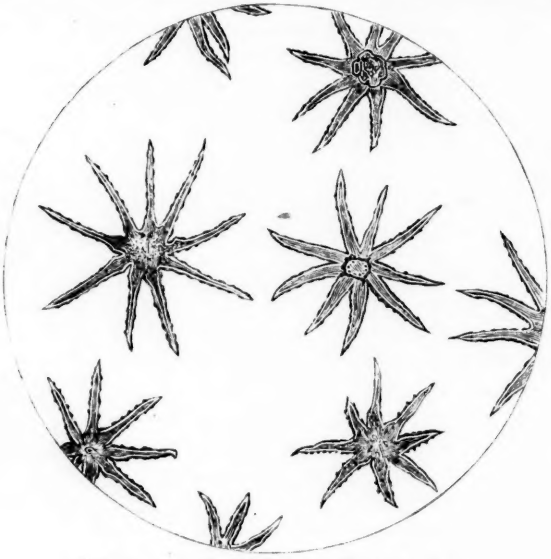

FIG. 20.—Star-shaped hairs on *Deutzia scabra*.

on the leaves of *Deutzia gracilis*. There are many scales of a similar character found on most of our ferns.

De Candolle, in his Vegetable Organography, says of the hairs of plants: "Some are very tender, others very rigid, and most are of all the intermediate degrees. With regard to their direction, some are vertical to the surface from which they spring; some more or less incline forwards; others more or less backwards; some are perfectly straight, others hooked at the point; there are several which are contracted, or which are interwoven with one another. As to their form, they are found as cylinders and very cylindrically-elongated cones. They are sometimes seen in the form of reverse cones, among those that are ramified they are found forked, with two, three or a greater number of branches; or starred at their apex, or divided at their base into branches which seem as so many distinct hairs reunited into bundles, having a common base."

Sachs says, "The first indication of the formation of hairs occurs in the papillose protuberances of the epidermis of many petals, to which their velvety appearance is due. To the simplest forms belong also the root-hairs which grow from the epidermis of true roots or underground stems (*Pteris aquilina* and *equisetum*), they are thin-walled bag-like protuberances of the epidermis cells which lengthen by growth at the apex."

The *Petunia* of our gardens is rendered sticky and unpleasant to the touch on account of one-celled glands raised

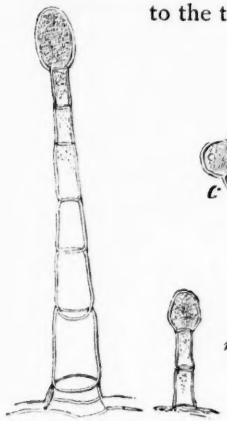

FIG. 21. FIG. 22.
Glandular hairs of *Petunia*.

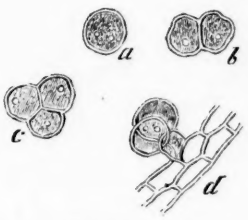

FIG. 23.
Glands on *Scrophularia nodosa*.

FIG. 24.
Glandular hair of *Verbena*.

FIG. 25.
Lower side of gland.

FIG. 26.
Top of gland.

on a stem of two to seven cells. *Scrophularia nodosa*, the figwort of our rich bottom lands, has numerous glands on its surface. These are composed of one, two, three or more cells raised on a short stalk. Some of the larger glands are more expanded into flattened spheres, and are much like those found on our garden verbenas next to be mentioned. The gland of the garden verbena consists of a large cluster of about thirty-five cells at the tip of a delicate stalk. The top of the gland is seen in Fig. 26, and appears to have about thirty rays and some central pieces of irregular shape. The lower surface of the gland, when it breaks off, shows two rings, one within the other. The inner is seen first, and on turning down the tube of the microscope the outer ring is seen. The gland is full of a purple substance. Figs. 27 and 28 exhibit the four-celled glands of the tomato plant. Each cell, as in many other cases, shows a nucleus, and some of them

one or more nucleoli. Besides the short hair and the gland of

FIG. 29.

FIG. 27.

FIG. 28.

FIG. 27.—Side view of glands on Tomato. FIG. 28.—Top view. FIG. 29.—Hair and protuberance on Tomato.

the watermelon plant, shown in Figs. 30 and 31, there are large numbers of other very long-jointed hairs. Figs. 32 and 33 show us two hairs of *Phlox drummondii.* Here the glands appear to be composed of four or more cells. Some of the glands of this plant consist of a single cell. Fig. 34, *a*, *b* represent some of the smallest hairs on *Martynia proboscidia.*

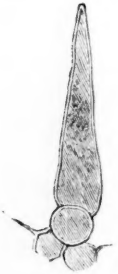

FIG. 30.
Short hair of plant of watermelon.

FIG. 31.
Glandular hair of watermelon.

FIG. 32.
Hair of *Phlox Drummondii.*

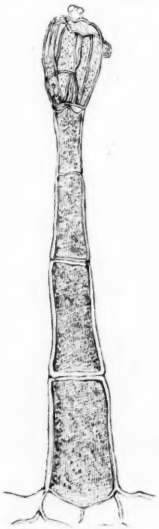

FIG. 33.
Hair of *Phlox Drummondii.*

Besides a few of these small hairs, the whole surface of the plant, including the sepals and petals, is thickly covered with glandular hairs as shown in Figs. 35, 36, 37. These glands, as do most glands of other plants to a greater or less extent, secrete a sticky substance which is usually increased in quantity by irritation.

From the end of the gland, when touched may be drawn out a gossamer thread of some length. The pulling out of the thread exhausts the gland in whole or in part, and causes it to collapse or change its shape. Fig. 36 shows a gland from which such a thread has been drawn.

FIG. 34.
Hairs of Petunia.

The fruit of *Tecoma radicans*, trumpet creeper, has on its surface numerous sessile cup-

FIG. 35.

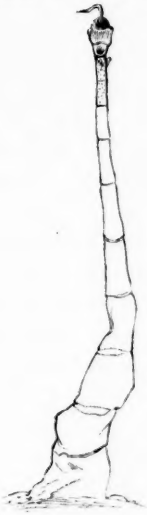

FIG. 36.

FIG. 37.

FIGS. 35, 36, 37.—Glands of *Martynia*.

FIG. 38.
Tip of gland of *Martynia*.

FIG. 39.
Tip of gland of *Martynia*.

shaped glands of which Fig. 40 shows a vertical section. In damp weather, or when not exposed to very dry air, these cups

FIG. 40.—Gland of *Tecoma radicans*.

FIG. 41.—Spot on fruit of same.

FIG. 42.—Stoma on fruit of same.

are heaped full with a drop of glistening liquid in each. Besides these, on the surface are numerous spots, like Fig. 41, in which numerous cells are clustered into a circular form. From these we may find all gradations down to a two-celled stomate, as in Fig. 42.

On each margin of the petiole of *Viburnum opulus* and *Passiflora* are some cup-like glands which exude a sticky substance. Similar glands are found on the petioles of the cherry and some peaches.

For our present purpose enough of these hairs and glands have been described and illustrated. A large majority of plants possesses something of this nature in a greater or less degree. When fresh, and especially when not exposed to direct sunlight or air which is too dry, these glands are covered with a spherical glistening drop which is often several times the diameter of the gland.

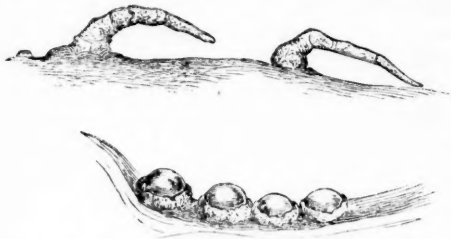

FIG. 43.—Glands on petiole of Snowball.

The uses of these hairs and glands we probably now understand to some extent, but in other cases we can only guess their office. The slender-pointed hairs may serve to some extent to ward off insects. These and the scale-like hairs may prevent the delicate surface from being scorched by the sun. This is not very probable, because most of the hairs on leaves are on the under side away from the direct rays of the sun. In the case of the common mullein, the thick branching hairs probably make the plant offensive to cattle and other animals. In a similar way other plants are protected from animals.

When packed within the bud scales during winter, the young leaves and flowers of many of our trees and shrubs are well protected by these soft hairs which envelope the tender parts like a mass of cotton or wool. After expansion of the buds these hairs generally drop off.

When the hairs or spines are stout and point backward, as in *Galium* and *Leersia*, they serve well to hold up the weak plant as it rises among stouter objects.

Fruit with hooked hairs is likely to be scattered by holding fast to animals. The bloom on a cabbage leaf or plum, and the thick hairs on plants prevent them from becoming wet on the surface. The shield and star-shaped scales on *Shepherdia* and *Deutzia*, and others, may serve the same purposes as hairs. These delicate objects must protect the plant from injury on account of sudden changes of the weather. The advantage of the sting of the nettle to the plant is obviously a means of self-protection.

The function of glandular hairs in some cases is a great mystery. In the case of *Martynia* the writer found it caught immense numbers of small insects, and in some way seems to suck out their substance. Small insects are found to a greater or less extent caught and held fast by the glandular hairs on all or most of the plants which produce glands. In his Insectivorous Plants Mr. Darwin, by experimenting, concludes that the glands of *Droseras* devour animal substances. The same conclusion is reached in case of numerous other plants, as some *Saxifragas*, *Primulas*, *Pelargoniums*, *Pinguiculas*.

The glands of the trumpet creeper are active, even till the fruit is of full size and quite near maturity. They are much visited by flies, wasps, and especially by ants to such an extent that the plant is often considered a nuisance when placed near the house. The glands on the leaves of cherry trees and *Viburnum* are also much frequented by insects. The base of the leaves of the sunflower, locust, *Pteris aquilina* (a fern) and numerous other plants are freely visited by insects. Of what benefit it can be to *Tecoma*, *Pteris*, *Helianthus* and the cherry to be thus visited by ants is beyond my certain knowledge.

The glands of tomatoes, tobacco, petunia and many other plants secrete a substance which is offensive to most insects and other animals which might otherwise devour the plants.

Mr. Darwin has also shown that some of these plants do certainly absorb and appropriate gaseous and liquid bodies. Many ingenious experiments were made on plants of several different orders, showing that "they detect with almost unerring certainty the presence of nitrogen." Plants by their glands were fed with green-peas, raw meat, a decoction of grass leaves. These substances "are acted on in exactly the same manner as by gastric juice."

Why may not these glands also draw nourishment from the particles of dust which fall on them from the air, or from the particles of soil which in many cases accumulates to such an extent as to completely cover some portions of the plant? As root hairs are active in absorbing materials from the soil including something from solid substances, why should not these active glands absorb materials from the dust and fragments of soil? The free presence of the air and light may also assist in this supposed action. This covering of the plant by the particles of soil held by

the hairs and glands may also save the plant from destruction by animals.

Of one thing the writer is certain, that these delicate objects are interesting to study. Situated as they are in immense numbers and in such great variety on the surface of so many plants, they are easily obtained and easily prepared for examination. They are excellent objects for a beginner in the use of the compound microscope; and for protracted and careful experiments, they are worthy the skill of the most accomplished scientist. In them we may spend weeks to advantage in observing the development of cells, the nucleus and nucleoli, and the gyration of the sap. In form and color they are exquisitely beautiful, while in variety they are inexhaustible.

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ON THE TRANSFORMATIONS AND HABITS OF THE BLISTER-BEETLES.

BY CHAS. V. RILEY, A.M., PH.D.

[*Continued from the April Number.*]

History of Epicauta.—It is generally stated by writers on the Hive-bee that the Oil-beetle (*Meloë*) is one of its parasites. The possibility that our more common blister-beetles were similarly parasitic on bees, taken in connection with the frequent complaints from apiarians of the wholesale death of bees from causes little understood, led me, some years since, to pay attention to the biological characteristics of the blister-beetles, in the hope of ascertaining whether or not they really bear any connection with bee mortality. From these investigations I am satisfied that *Meloë* is only parasitic on the perfect Hive-bee as it is on so many other winged insects that frequent flowers; and that it cannot well, in the nature of the case, breed in the cells of any social bee whose young are fed by nurses in open cells.

I have had no difficulty in getting the eggs or the first larva of several of our vesicants, and described some of them at the Hartford (1874) meeting of the Am. Ass. Adv. Sc.; but these young larvæ refused to climb on to plants furnished to them, or to fasten to bees or other hairy insects. Nor would they nourish upon honey, bee-bread, or bee larvæ on which they were placed. They showed a proclivity for burrowing in the ground, and acted quite differently from those of *Meloë* or *Sitaris*, which not

only readily attach to bees in confinement, but which, in the case of *Meloë*, I have known to so crowd upon mature hive bees as to worry them to death and cause extended loss in the apiary. Explorations into the nests of Solitary bees gave no clue, and, in fact, the immense numbers in which the more common blister-beetles occur, rendered a parasitic life upon such bees highly improbable. In sweeping plants and flowers with the net, I had never met with any of the first larvæ with which I had become familiar, as already indicated; while I had on several occasions, in digging ground where there was no trace of bee nests, met with the curious pseudo-pupa so characteristic of the family. While analogy and the law of unity of habit in species of the same family pointed, therefore, to a parasitic life, I began to conclude, from the facts just stated, that the parasitism was of another kind, having satisfied myself by various experiments that the triungulins did not feed on roots. Few discoveries are stumbled upon. We find as a rule that only which we anticipate or look for. In 1876, in digging up the eggs of the Rocky Mountain locust (*Caloptenus spretus*) at Manhattan, Kansas, the pseudo-pupæ were not unfrequently met with. The thought at once occurred to me that locust eggs might be the proper food for these blister-beetle larvæ, and it was encouraged by the fact that the Meloids abound most in those dry western regions where the Acrididæ most prevail, and by a pretty distinct recollection, which my notes support, that the years when the vesicants were most injurious to potatoes had been preceded by dry Falls, during which there had been much locust injury and, necessarily, unusual locust increase. The suspicion thus raised that these blister-beetles preyed in the preparatory states upon locust eggs was confirmed last spring by finding the larvæ of different ages within the egg-pods and devouring the eggs of *Caloptenus spretus*. Mr. A.N.Godfrey had, also,

FIG. 3.—*Epicauta vittata*: normal form.

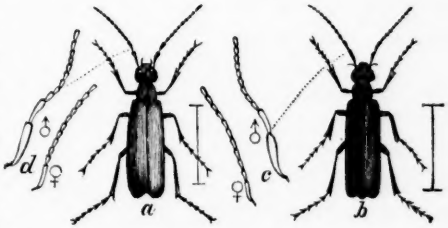

FIG. 4.—*Macrobasis unicolor*:—*a* normal, gray form; *b*, black (*murina*) form; *c*, *d*, male and female antennæ of either.

no difficulty, under my directions, in finding them last May at Manhattan; while they were sent to me among other locust-egg parasites by Mr. Seth H. Kenney of Morristown, Minn., and from St. Peters in the same State by Prof. Cyrus Thomas.

From such larvæ preying on the eggs of *C. spretus* I have reared the unicolorous form of *Epicauta cinerea* (Forster), or the margined Blister-beetle[1]; the *Epicauta pensylvanica* (DeGeer),[2] or the Black Blister-beetle; the *Macrobasis unicolor* (Kirby)[3] or the ash-gray blister-beetle; and the form of it described as *murina* by LeConte, or the black-rat blister-beetle.

Since then I have found it very easy to trace the larval habits and development of the two more common potato-feeding species around St. Louis, viz: the striped blister-beetle (*Epicauta vittata*, Fabr.)[4] and the Margined Blister-beetle (*marginata* Fabr.) just alluded to.

Careful examination of locust eggs in the vicinity of potato fields frequented by these beetles show a varying proportion of the egg-pods affected, and in some locations nearly every pod of the differential locust (*Caloptenus differentialis*) will contain the *Epicauta* larva. The eggs of this locust are laid in large masses of 70 to about 100. The pod is but slightly bent, rather compact outside, while the eggs are irregularly ar-

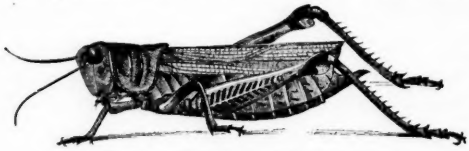

FIG. 5.—*Caloptenus differentialis.*

[1] The black, gray-margined form, very appropriately described by Fabricius as *marginata*, is referred to *cinerea* Forster by modern systematists, and specifically united with it by Dr. Horn. Yet the fact remains that the two are not ordinarily, if ever, found commingled. The margined form is very common in potato fields in Missouri. It shows little variation and is found almost invariably in conjunction with *vittata*, but not with the unicolorous form in question, which is most common farther west and occurs abundantly without the margined form—all which is against the specific union of the two.

[2] = *E. atrata* Fabr.

[3] = *M. cinerea* Fabr., *Fabricii* Lec., *murina* Lec., *debilis* Lec. I accept Dr. Horn's conclusion that the last two are but poorly developed forms of this species. Yet the *murina* form is not due to rubbing or injury, but issues from the pupa without a trace of gray scales on the elytra.

[4] = *E. lemniscata* Fabr. Dr. Horn retains *lemniscata* as a distinct species in his Revision already referred to. The outer stripe in the bi-vittate specimens divides up in others so as to give the tri-vittate character on which *lemniscata* is founded. Both extremes and every possible variation between them occur constantly together in the same potato field in Missouri, and there are no other differences of specific value.

ranged, and capped with but a shallow covering of mucous matter. It is the egg-pod of this species which the larvæ of the two Blister-beetles in question prefer; for while they will feed upon those of other species in confinement, I have so far found none in the deeper-necked, narrower, more compact egg-pods either of *Caloptenus femur-rubrum*, *C. Atlantis*, or *Œdipoda sulphurea*, in which the eggs are regularly and quadrilinearly arranged, as in those of *C. spretus*. Not only have I found a large proportion of the egg-pods of *C. differentialis* naturally infested with these *Epicauta* larvæ, but I have succeeded in hatching and rearing numbers in-doors.

From July till the middle of October the eggs are being laid in the ground in loose, irregular masses of about 130 on an average —the female excavating a hole for the purpose, and afterwards covering up the mass by scratching with her feet. In confinement she sometimes omits both these instinctive acts and oviposits on the surface of the ground. She lays at several different intervals, producing in the aggregate probably from four to five hundred ova, judging from examinations made on the ovaries of some that were gravid. She prefers for purposes of oviposition the very same warm sunny locations chosen by the locusts, and doubtless instinctively places her eggs near those of these last, as I have on several occasions found them in close proximity. In the course of about 10 days—more or less, according to the temperature of the ground—the first larva or triungulin hatches. The hatching takes place without the aid of any *ruptor ovi*, for the egg-shell is so delicate that it easily splits, from mere expansion, along the back near the head, and breaks and shrivels up with the escape of the larva. These little triungulins (Pl. 1., Fig. 2), at first feeble and perfectly white, soon assume their natural light brown color and commence to move about. At night or during cold or wet weather all those of a batch huddle together with little motion, but when warmed by the sun they become very active, running with their long legs over the ground, and prying with their large heads and strong jaws into every crease and crevice in the soil, into which, in due time, they burrow and hide. Under the microscope they are seen to fairly bristle with spinous hairs, which aid in burrowing. As becomes a carnivorous creature, whose prey must be industriously sought, they display great power of endurance, and will survive for a fortnight without food

in a moderate temperature. Yet in the search for locust eggs many are, without doubt, doomed to perish, and only the more fortunate succeed in finding appropriate diet. Upon the slightest disturbance they curl up in a ball with the head bent pretty closely on the breast.

Reaching a locust egg-pod, our triungulin, by chance, or instinct, or both combined, commences to burrow through the mucous neck, or covering, and makes its first repast thereon. If it has been long in the search, and its jaws are well hardened, it makes quick work through this porous and cellular matter, and at once gnaws away at an egg, first devouring a portion of the shell, and then, in the course of two or three days, sucking up the contents. Should two or more triungulins enter the same egg-pod, a deadly conflict sooner or later ensues until one alone remains the victorious possessor. By the time the contents of an egg are consumed, the body of the parasite has perceptibly increased so that the white sutures between the segmental plates show conspicuously, especially as there is a tendency on the part of the animal to curve its body, and bring the sutures more into relief. A second egg is attacked and more or less completely exhausted of its contents, when a period of rest ensues, the triungulin skin splits along the back and there issues the *Second Larva* (Pl. 1., Fig. 4)—white, soft, with reduced legs and quite different in general appearance from the first. This molt is experienced about the eighth day from the first taking of nourishment. The animal now naturally lies in a curved position (Pl. 1., Fig. 4, *d*), but, if extracted from the egg-pod, will stretch itself and move with great activity, reminding one very strongly of many Carabid larvæ, for which reason I would designate this as the *Carabidoid* stage of the second larva. After feeding for about another week, a second molt takes place, the skin, as before, splitting along the back and the new larva hunching out of it until the extremities are brought together and released almost simultaneously. This kind of molting, which is characteristic of our blister-beetles up to the pseudo-pupal state, is exceptional among insects, the skin being ordinarily worked backward from the head. The modification at this molt is slight. The mouth-parts and legs become rudimentary and the body takes on more fully the clumsy aspect of the typical Lamellicorn larva, for which reason I designate this as the *Scarabæidoid* stage of the second larva.

Another six or seven days elapse and the scarabæidoid skin is rent and shed with but slight modification in the form and characters of the animal. In this, the Ultimate stage of the second larva (Pl. 1., Fig. 5) the creature grows apace, its head being constantly bathed in the rich juices of the locust eggs, which it now rapidly sucks or more or less completely devours. The color is more yellowish than it was before, and the power to stretch and travel on the venter on an even surface is still retained. In another week it forsakes the remnants of the pabular mass, and, by burrowing a short distance in the clear soil, avoids the deleterious decaying influences of these egg remnants. In the soil it forms a smooth cavity, within which it lies stretched on one side, motionless and gradually contracting. The skin separates and becomes loose at the end of the third or fourth day, when it splits on the top of the head and thoracic joints and is worked toward the extremity, but never fully shed. The mouth-parts and legs are now quite rudimentary and tuberculous, the soft skin rapidly becomes rigid and of a deeper yellow color, and we have what has been called the semi-pupa (Pl. 1., Fig. 8). The term pseudo-pupa given it by Fabre is more appropriate, and I should prefer myself to call it the *coarctate larva*, for it is nothing but a rigid and dormant larval stage, having its counterpart in the well-known "flax-seed" stage of the Hessian-fly larva and in the so-called coarctate pupa of the Diptera generally. A similar dormant but less rigid larval stage occurs with many Tenthredinidæ in Hymenoptera, and, in fact, the summer dormancy of certain Lepidopterous larvæ and the winter dormancy of others is analogous. We find something similar, therefore, in all the orders undergoing complete transformations, but in no insects is the change so marked and exceptional or the freeing of the subsequent larva from the coarctate larva so striking as in these Meloidæ. The insect has the power of remaining in this coarctate larval condition for a long period, and generally thus hybernates.

In spring the coarctate larval skin is, in its turn, rent on the top of the head and thorax, and there crawls out of it the *Third Larva*,[1] which differs in no respect from the ultimate stage of the second larva already mentioned, except in the somewhat reduced

[1] The coarctate larva is, properly speaking, the third, and that following it the fourth; but just as I have preferred to designate as special stages of the second larva the stages between the first and fourth molts, so I prefer to call the last larva the third, to conform to the nomenclature now generally employed.

size and greater whiteness. The coarctate skin, when deserted, retains its original form almost intact. The third larva is rather active, and burrows about in the ground; but while there seems to be no reason why it should not feed, nourishment is not at all essential, and all my specimens have, in the course of a few days, transformed to the true pupa without feeding. In the transformation to pupa (Pl. 1., Fig. 9) the third larval skin is worked into a wrinkled mass behind, as is also the skin of the true pupa when shed. The pupa state lasts but five or six days, and before the wings of the imago are fully expanded, or the abdomen contracted, the general aspect of *Epicauta* forcibly recalls the mature *Henous*.

Like all parasitic[1] insects that nourish on a limited amount of food and possess no power to secure more, the blister-beetles vary greatly in individual size in the same species, and the larvæ have the power of accommodating their life to circumstances, and of assuming the coarctate larval form earlier or later according to the size of the egg-mass which they infest. I have had some interesting illustrations of this in my experiments with them. In an average sized egg-pod of the differential locust, however, there are more than enough eggs to nourish the largest specimen of *E. vittata*, and a few are usually left untouched.

The period of growth, from the first feeding to the coarctate larva, averages, as will be gathered from the foregoing, about a month; yet in the month of September, out-doors, under screens where I have had the differential locust oviposit for the experiment, I have known the full larval growth of *E. vittata* to occupy but 24 days. As this species occurs in the beetle state as early as June in the latitude of St. Louis and as late as October, there are possibly two annual generations here and farther south.

Larval Habits of Macrobasis and Henous.—The characteristics of the triungulins of the blister-beetles, represented by *Epicauta* and *Henous*, are remarkably similar, and point to unity of habit. The same holds true of the characters of the second, coarctate and third larva and of the pupa of *Epicauta* and *Macrobasis*. They are precisely alike; so that, while appreciable differences may be found in the triungulins, it is doubtful whether the subse-

[1] An insect is not properly parasitic that simply feeds on eggs, but the term is permissible and even necessary to characterize and distinguish those species which develop within and are confined to a locust egg-pod, from the predaceous species that are not confined but pass from one pod to another.

quent developmental stages will indicate specific or even generic differences in species of similar size in these three genera.

That the eggs of *Epicauta* may exceptionally hybernate is possible, but, from their delicate nature, improbable. That the triungulins frequently do so there can be no doubt, especially in species like the Black Blister-beetle, which is found on the flowers of Solidago, Eupatorium, etc., till the end of October, and continues laying till frost. I have at the present time (November) many of these last that are quietly huddled together, and, with winter temperature, will doubtless remain so; while others have worked in between the locust eggs, there evidently to remain without feeding till spring opens. I have also found as many as five triungulins of this species curled up in the deep red mucous matter that surrounds the eggs of *Œdipoda phanæcoptera*—all numb and torpid, and evidently hybernating.

Conclusion.—From the foregoing history of our commoner blister-beetles, it is clear that while they pass through the curious hypermetamorphoses so characteristic of the family, and have many other features in common, yet *Epicauta* and *Macrobasis* differ in many important respects from *Meloë* and *Sitaris*, the only genera hitherto fully known biologically. To resume what is known of the larval habits of the family, we have:

1st—The small, smooth, unarmed, tapering triungulin of the prolific *Sitaris*, with the thoracic joints subequal, with strong articulating, tarsal claws on the stout-thighed but spineless[1] legs, and, in addition, a caudal spinning apparatus. The mandibles scarcely extend beyond the labrum; the creature seeks the light, and is admirably adapted to adhering to bees but not to burrowing in the ground. The second larva is mellivorous, and the transformations from the coarctate larval stage all take place within the unrent larval skin.—We have:

2d—The more spinous and larger triungulin of the still more prolific *Meloë*, with long caudal setæ, but otherwise closely resembling that of *Sitaris* in the femoral, tarsal and trophial characters, in the subequal thoracic joints, in the unarmed tibiæ, and in the instinctive love of light and fondness for fastening to bees. The second larva is also mellivorous, but the later transformations take place in the rent and partly shed skins of the second and coarctate larvæ.—We have:

[1] The larva of *S. humeralis* appears to differ from that of *S. colletis* in having hairs on the femora and tibiæ.

3d.—The larger and much more spinous triungulins of the less prolific *Epicauta*, *Macrobasis*, and *Henous;* with unequal thoracic joints, powerful mandibles and maxillæ, shortened labrum, slender femora, well-armed tibiæ, slender, spine-like, less perfect tarsal claws—combined with an instinctive love of darkness and tendency to burrow and hide in the ground. The second larva takes the same food as the first, its skin is almost entirely cast from the coarctate larva, while the subsequent changes are independent and entirely free of the shell of this last.

Larval Habits of Cantharis.—The question naturally arises here, whether *Cantharis*, in its larval habits, will most agree with *Meloë* and *Sitaris* or with *Epicauta*. The triungulin, except in becoming almost black, has much in common with *Meloë*, in the subequal thoracic joints, and the long antennæ; also in its habit, observed by Lichtenstein, of fastening to bees.[1] The fact that it can nourish on honey, though it does not appear to do so freely, would also indicate that it breeds in the nests of solitary bees. Nevertheless, in the slender thighs and the caudal and abdominal characters it agrees more nearly with *Epicauta*, and in the stage following the first molt the legs are still quite long and the general aspect much like the carabidoid stage of that genus. I should not be surprised, therefore, if *Cantharis* also nourished on locust eggs.

What is Known of the Larval Habits of other Meloid Genera.—*Mylabris* Fabr. (*nec* Geoff.), according to V.-Mayet, is much less prolific than any Meloids so far observed. The egg is 2.5 mm. long and is ½ as wide, with a tolerably thick shell and the embryo more fully bent within it. The triungulin has many of the characters of *Epicauta*, judging from the published description (*Ann. Soc. Ent. de Fr.*, 1876, p. cxcvi.), which is, however, not sufficiently detailed as to the trophi. I doubt not that the genus will be found to infest locust eggs.

Horia Fabr., from what little is known of it, would seem to have a similar partial parasitism to *Meloë*, but on carpenter bees.

Tetraonyx Latr., was found by Guérin-Meneville in places frequented by bumble-bees.

The eggs of *Apalus* Fabr., as well as its triungulin, are said to resemble those of *Meloë*.

Zonitis Fabr., is known to develop in the cells of *Osmia* and *Anthidium*, and to have a coarctate larva much like that of *Sitaris*.

[1] Since this was published M. Lichtenstein writes me: "They only fasten to bees when enclosed in tubes with them. At liberty they do not climb flowers, like *Meloë*, in search of bees, but run quickly on the soil, just as you describe for *Epicauta*."

THE SIRENIA.

BY ARTHUR E. BROWN.

AS the name of this curious order of aquatic mammals was suggested, without doubt, by the probability that they, in great measure, gave origin to the ancient myths regarding the existence of sirens or mermaids, it may not be inappropriate to take a first look at the animal as it appeared to a sailor of Capt. Weddell's Expedition towards the South Pole, about the close of the first quarter of the present century. "The sailor had lain down and about ten o'clock he heard a noise resembling human cries; and as daylight in these latitudes never disappears at this season, he rose and looked round, but on seeing no person he returned to bed; presently he heard the noise again, rose a second time, but still saw nothing. Conceiving, however, the possibility of a boat being upset, and that some of the crew might be clinging to some detached rocks, he walked along the beach a few steps and heard the noise more distinctly, but in a musical strain. Upon searching round he saw an object lying on a rock a dozen yards from the shore at which he was somewhat frightened. The face and shoulders appeared of human form and of a reddish color; over the shoulders hung long green hair; the tail resembled that of the seal, but the extremities of the arms he could not see distinctly. The creature continued to make a musical noise while he gazed about two minutes, and on perceiving him it disappeared in an instant."

Notwithstanding the fact that the sailor testified his belief in his story by making a cross in the sand and kissing it, we who look on the manatee and dugong, with minds cleared from a delusive belief in mermaids and mermen, are tempted to agree with Capt. Weddell in the last clause of which he makes use in relating the circumstance: "I concluded he must really have seen the animal he described, or that it must have been the effects of a disturbed imagination."

Naturalists, however, have had almost as much trouble, in times past, to determine where these animals structurally belong, as the old explorers had to decide whether they were forms of earthly or supernatural origin. They were classed in the old order *Pachydermata* on account of their points of resemblance to the elephant; then they were put with the whale and the porpoise in

the *Cetacea*, and they are now generally regarded as an independent order, known as *Sirenia*, allied more closely with the Ungulates than with any other living mammals; they—the vegetable eaters of the sea—being doubtless descended from some form of terrestrial Herbivora, as the Seals, Whales, etc.,—the aquatic Carnivores—probably claim parentage among the terrestrial Carnivora.

The earliest Sirenian known to Palæontology is the *Halitherium*, found in the Miocene formation of Central and Southern Europe. Those now existing are separated into two genera,—*Manatus* and *Halicore*, and, generally speaking, there is a strong resemblance between all members of the group.

They all possess a cylindrical body tapering towards each end from a point just in advance of the middle; the tail is flat and horizontal; the hind limbs are entirely wanting; the fore limbs are placed far forward on the breast and are covered with integument like the rest of the body; the nipples are two in number, and, as in the human species, are situated on the breast; the neck is thick and is not separated by a well drawn line of demarcation from either the head or the body; the head is rather small and round, the lips being thick and fleshy; the eyes are round and of small size and the nostrils, situated on top of the extreme end of the snout, are closed with a valve; the presence of an ear is only to be recognized by a sort of crease in the skin; the hide, in appearance and toughness, much resembles galvanized rubber and is covered very scantily with stiff bristles an inch or two long, these are so sparsely scattered, however, that it requires a close inspection, almost, to see that they are there,—around the lips and mouth they are longer and more plenty and are deserving almost of the name of whiskers. In these characters all the Sirenians agree.

The two genera composing the order are, however, recognizable at a glance, and the species into which they are divided, though closely allied, yet present characters which are held to be sufficiently distinctive for the recognition of two species of dugong and three of manatee.

The one genus, *Manatus*, is found altogether in the waters of the Atlantic Ocean, with the single exception of a small part of the East coast of Africa, north of the Cape of Good Hope, while the other genus, *Halicore*, is strictly confined to the South Pacific and Indian Oceans. No species are found in the Northern

Hemisphere much beyond lat. 30°, and they are common in the greatest numbers in the equatorial and warmer temperate zones.

Manatus latirostris is found in San Domingo and other parts of the West Indian Islands, on the Atlantic coast of Florida and sparingly along the Gulf of Mexico, down to the neighborhood of Honduras, where it gradually merges into *Manatus australis*, which follows the northern and eastern coast of South America to lower Brazil, reaching not much beyond the 20th degree of south latitude.

Crossing the South Atlantic, *Manatus senegalensis* is first found on the western coast of Africa, about the upper part of Senegambia, from which point it ranges southward along the Atlantic coast, around the Cape of Good Hope and up the east coast as far as the Mozambique Channel. Here the first representative of the dugongs, *Halicore dugong*, makes its appearance, about where the last species ends, and ranges up the east coast of Africa, along both shores of the Red Sea and the southern coast of Asia as far as Cochin China; taking in Borneo and the leading islands of the Indian Archipelago lying to the westward of the Straits of Lombok, which marks strictly the boundary line between the Indian fauna and that of the Australian region. The one remaining species, *Halicore australis*, ranges along the northern shore of Australia and down the eastern coast of that continent, which is washed by the waters of the South Pacific, to about latitude 30° south. It was stated by Hernandez that he had found an animal supposed to be either *H. dugong* or *H. australis* on the coast of Peru and Ecuador. Individual members of the order have also been seen on several occasions in the neighborhood of the British Islands; it is probable that these belonged to *M. latirostris* and that they were transported by the Gulf Stream from Florida or the West Indies. It is thus seen that the polar extremes in range of the *Sirenia* are about the 30° of latitude, north, in the United States, and the 35°, south, at the Cape of Good Hope.

They live generally about the mouths of rivers and are even found up the streams to a considerable distance from the coast, rarely being common in water of more than several fathoms depth. It is stated also that in Africa they inhabit fresh water lakes near the coast,—this is not, however, beyond dispute and is doubtful, except by supposing a water communication with the main sea. All are strictly herbivorus, feeding on the water plants which grow in great profusion in the localities which they frequent.

The manatee rarely attains a length of more than eight to ten feet. The tail, like that of the dugong, is horizontally placed, but differs from that species in being evenly rounded on the end; the fore extremities are short and weak; the fingers are enclosed together in one fold of integument and bear faint vestiges of nails; the skin is thick and very tough and of a lead or slate color. There are no incisor or canine teeth in the adult, and the molars are thirty-eight in number,—twenty in the upper and eighteen in the lower jaw. These are not all present, however, at any one time, as they successively come out, fill their purpose and are succeeded by others in turn. The bones of all the Sirenians are massive and heavy; the animals, therefore, possess little buoyancy in their native element and are not much disposed to rapid motion.

The main points of difference between *M. australis* and *M. senegalensis*, according to Prof. Owen, are in the larger skull of the former and in the conformation of the malar bone and of the mandible or lower jaw. *M. latirostris* is said to resemble the African form more closely than it does its nearer neighbor on the American coast.

Several efforts have been made to keep the manatee alive in confinement, but without much success. One of the most satisfactory attempts was made in the summer of 1876, by the Zoölogical Society of Philadelphia, and as the habits of the animal are not very widely known, a few words descriptive of the manner in which this specimen passed its time may not be uninteresting.

The animal was a female, not fully adult, about six feet long, and was captured in the Orinoko river. She was put in a tank containing about a foot of water and was shipped from Demerara in May, arriving in Philadelphia on the 15th of June, apparently uninjured by the tossing to which the vessel had been subjected during the voyage. She was at once placed in a glass tank containing about forty-five hundred gallons of water, at a temperature of about 75 degrees,—the weather being warm, this was about the natural degree, and only once while the animal lived was it necessary to heat the water artificially to keep it at this point.

The great difficulty was to get it to feed. The ship captain who brought it up, said, "Oh! there is no trouble about that, it will eat anything," and insisted that he had been feeding it on ship-biscuit and cabbage, but when this was tried, the ship-biscuit

might as well have been cobblestones and the cabbage had about as much effect as a piece of rag carpet, so it was tempted with all the delicacies of the season in the way of vegetables, in the hope that something more easy to obtain than river grass might prove acceptable, but nothing would do, so a variety of sea-weed and aquatic plants were placed at its disposal: sedge grass, *Myriophyllum* and *Sagittaria* were to be had in large quantities, but did not seem to be exactly the thing, until at last a variety of *Potamogeton* was found which the animal took to at once and in a month it had eaten all there was in the Schuylkill and Delaware rivers within reaching distance of Philadelphia, and it became necessary to give it something else—generally *Sagittarias*, of which it ate the heads—while a new crop was growing up. It was remarkable to see with what dexterity the animal, though seemingly deficient in all the senses, would pick out the stalks of its favorite food from among a wheelbarrow load of stuff thrown into the tank. In this it appeared to me to be guided more by its sense of smell than by sight,—which agrees perfectly with the observations of Dr. H. C. Chapman, Prosector of the Society, on two specimens which had previously been kept in the garden, and also with the result of his dissection of those animals, which showed that the olfactory nerves were well developed.

The manner of introducing food into the mouth appeared to be peculiar; the upper lip being chiefly used, and that by a motion rather lateral than downwards. The lip is fleshy and tumid, incapable of much mobility and is cleft in the centre, like a hare lip, and the motion seemed to be produced by muscular contractions, drawing the sides inward and toward the cleft, bringing into play the bristles with which they are clothed, almost as organs of prehension.

It was difficult to observe this action, as the animal seemed to be somewhat nocturnal and fed at night; the water also became discolored by the mud which adhered to the plants, and the animal, when feeding, quickly became obscured to view.

It had been stated that the manatee was in the habit of crawling partly out on the bank for the purpose of obtaining food; as it did not seem probable that the animal could move to any extent on land, considering the weakness of its fore-limbs, this was tested in the following manner: A shelf was arranged gently sloping at an angle of about 30° from one side of the tank so that its

lower edge was under water, this was covered with wisps of straw so as to bear some resemblance to the sloping bank of a stream covered with sea-weed left by the ebbing tide. As the animal did not seem disposed to put even its nose on the shelf, its food was for some nights deposited there, just above the water line, with the result that it did not show the slightest disposition to help itself, until after some hours the grass was thrown into the tank, when it at once fed. It never manifested the least trace of a desire to raise itself out of the water, and certainly no structure could be worse adapted to move on land than the awkward bulky body and the weak flippers of the manatee.

The animal was never in good condition from the earliest period of its confinement, and was very apt to become costive, which was always relieved by throwing some soft river mud into the tank, which it swallowed with excellent effect. It appeared to be very fond of mud, and was always more lively when the water was discolored by heavy rains than at any other time. In general, through the day time it rested on the bottom of the tank, on its chin and the end of its tail, with the body slightly arched. Every two and a half minutes on an average, using its tail as a pivot, it raised its head to the surface by the action of its fore flippers, just so that its nostrils appeared above the water, and after taking breath sank at once to its former position at the bottom. Although sluggish and inactive in habit, the animal was not devoid of intelligence; it learned to recognize its keeper, and soon appeared to understand that no harm was intended when the water was drawn off from the tank for the purpose of cleaning. At such times, after the first few days, it lay perfectly quiet on its side, and allowed the keeper to sweep around and over it without making the least disturbance.

The animal lived a quiet unruffled existence, apparently as happy in its tank in a corner of the Carnivora House as it could have been in its natural home. Everything was done for it that it apparently could desire—a palace of glass kept clean without the least trouble to itself, clean water made brackish as that of its native haunts by a solution of marine salt, and carefully watched by the aid of a thermometer lest the cold air of the north should be too trying for a constitution accustomed to the warmth of the equator; plenty of that food which it selected as being best adapted to its wants, and in fact all that the most assiduous care

could suggest and procure, but liberty is liberty, and the waters of the Schuylkill were not those of its native Orinoko, and so after two days of extreme torpor and indisposition to eat, she was found on the morning of September 5th, resting on the bottom of the tank, having died as she had lived, peacefully, and with no more exertion than could by any possibility be avoided.

A careful post mortem examination revealed the presence of a large quantity of a fatty deposit about the region of the heart, exactly as had been the case in two specimens which had previously been kept in the Garden, and as it does not seem possible that accommodations more in accord with the native surroundings of the animal could be given in confinement and in so different a climate, or that the attempt could be made at a more favorable season of the year, it appears almost certain that the speedy death of these animals was owing to insuperable obstacles in the way of acclimating the species here. It is possible that the more northern member of the group, *M. latirostris*, which occasionally experiences a touch of frost in the St. Augustine river in Florida, and is presumably more hardy than those from more southern regions, might be better adapted to a residence in this latitude, but I do not know that the opportunity has ever been fully presented for the experiment. A pair of this species was at the Garden for some days in the month of August, 1876, but as the Society did not care to pay the large price demanded for them, they were removed by their owner to one of the Centennial side shows, where they were destroyed by a fire before they had been here long enough to give any indications as to how they were going to adapt themselves to the climate.

The dugongs grow to a larger size than the manatees, *Halicore dugong* being sometimes twenty feet long; their general appearance is similar, the tail, however, instead of being rounded is forked, and their color is bluish on the back, running into dirty white beneath. The alveolar process of the pre-maxillary bone is much elongated and bent downwards, giving the animal the appearance of having a nose of a very pronounced Roman type, and causing the mouth to open rather downwards.

There are two incisor teeth in the upper jaw of the adult male, and none in the lower jaw; in the female there are no incisors visible, their growth being arrested before they emerge from the socket. The number of molars varies in different individuals

according to age; it is stated that the full number in the adult dentition of *H. australis* is twenty-four, and twenty in *H. dugong*.

The habits of all the sirenians, so far as is known, are essentially similar, the dugong as well as the manatee being found around the mouths and up the water courses of the coast.

This order affords a most striking instance of the discovery and speedy extinction of a species, the *Rhytina borealis*, or *stelleri* of some authors, having been discovered on Behring's island in the sea of Kamschatka, by one of Behring's exploring parties, which was shipwrecked there in 1741. They existed in large numbers, were easily killed, and during the ten months which the shipwrecked party spent on the island, sad havoc was made among the animals. They were rapidly reduced in numbers, and in 1768, twenty-seven years after they became known to civilized man, the last one was killed. Almost all that is known of the living animal is from an account published in 1751, at St. Petersburg, by Steller, who was one of the discovering party, and who saw it in its native haunts.

The *Rhytina* was about twenty-five feet long, had a forked tail like that of the dugong, and was covered with a rough, wrinkled, brownish hide nearly an inch thick, composed of hair-like tubes agglutinated together into a substance somewhat like horn, and of so great toughness that it scarcely yielded to a blow of an axe. The adult animal was entirely devoid of teeth, and had in their stead a rough horny plate on the front of the palate, to which was opposed a similar one on the lower jaw.

The *Sirenia* are of considerable value to the natives of the countries which they inhabit; the hide is of use for making a thick leather, and the flesh is much esteemed for the table. It is said that the church, disagreeing with nature and science, determines that the manatee is a fish, and therefore the good Catholics of South America feast royally on its flesh on Friday and all other fast days.

AN EXAMINATION OF PROF. LEO LESQUEREUX'S THEORY OF THE ORIGIN AND FORMATION OF PRAIRIES.

BY O. P. HAY.

FOR many years past there has been no lack of literature on the subject of the prairies of the western states and territories, nor any dearth of theories to account for their origin. We have had their existence ascribed to fire and to water; to heat and to cold; to all sorts of phenomena and to the lack of them. The forests that once clothed these regions must have been burned up by prairie fires—before the prairies existed. They must have been drowned out by the waters of vast inland lakes that once covered these prairie states They must have been parched up up by the dryness of the climate. They must have been smothered by the impalpable fineness of the soil in which they grew. They never had an existence; because the seeds which ought to have produced them must have been ground to pomace by the glaciers of the Age of Ice, or hopelessly buried beneath their *débris*.

Prof. Leo Lesquereux, eminent in both recent and fossil botany, has published various papers on this subject, the latest of which appears in Vol. I. of the Illinois Geological Survey. In subsequent volumes of this excellent Survey this paper is frequently referred to; and certain phenomena observed in various portions of the state by the members of the survey corps, are cited as helping to establish Prof. Lesquereux's theory. As this scientific work will have a wide circulation amongst geologists; and since, on account of the high reputation of Prof. Lesquereux as a scientist, his opinions will have great weight in determining people's opinions concerning an important geological feature of the West, it is proposed in this paper to examine the grounds upon which the theory has been based, and to test its correctness. For the writer believes that the theory is insufficient to account for all the facts involved—is, indeed, opposed by many of them; and that those examples which have been cited by the geologists as confirming the theory, instead of so doing, are excellent proofs of the way in which prairies have *not* had their origin.

Prof. Lesquereux believes the failure of forest vegetation to occupy the praries to be due to the chemical nature of the soil, coupled with, as it would seem from his language, its exceeding fineness. He believes that all our prairies and Western plains, as well as the plains of South America, Europe and Asia, have been

formed as we may now see prairies of far less extent being produced along the shores of the lakes of the West and along the banks of rivers. "Where the waves or currents strike the shores or the low grounds and there heap material, sand, pebbles, mud, etc., they build up more or less elevated dams or islands. These dams are not always built along the shores, but often enclose wide shallow basins, whose waters are thus sheltered against any movement. Here the aquatic plants, sedges, rushes, grasses, etc., soon appear, these basins become swamps, and, as it can be seen near the borders of Lake Michigan, though the waters may surround them, the trees never invade them, never grow upon them, even when the swamps become drained and dried by some natural or artificial cause." Prof. Lesquereux states that such marginal swamps, generally fringed with trees, can be seen also along the shores of Lake Erie, and along the Mississippi and Minnesota rivers, outside the line of slack water. All gradations are to be found between such swamps and dry prairies. He hence concludes that all our prairies, not only the low prairies along our lakes and rivers bottoms, but also the high rolling prairies, have been produced by the slow recess of sheets of water of various extent; that these lakes have first been transformed into swamps and by and by drained and dried. The soil of these ancient swamps, having been produced by the slow and incomplete decomposition of aquatic plants, must be of impalpable fineness and thoroughly impregnated with ulmic acid; the former condition proving deleterious to the germination of the seeds of trees, the latter condition favoring the growth of the peculiar vegetation of the prairies.

But if the prairies were at one time swamps, why is their surface not now everywhere level, or nearly so? Or, if the existing elevations have been formed as low islands or dams in lakes, why are they not now wooded? Mr. Lesquereux believes that the surface was originally horizontal; but that it has been made to assume its present undulating character by the slow and long continued erosive action of water;—in short, that the broad, gently sloping valleys have been worn out by running waters as have the beds of our rivers and creeks; the difference being that in the former case the waters have had a very gentle, in the latter a more rapid motion.

Let us now consider the facts and argument presented by Prof. Lesquereux, to sustain his opinion.

And first, is it true that trees will not, as a general thing, grow in swamps, or in ground that has once been a stagnant marsh? That there are but few species of trees that will grow in swamps covered with stagnant water none perhaps will deny; but that these same swamps will not, after they have been drained and dried, allow the growth of arborescent vegetation remains to be proved. All of Prof. Lesquereux's arguments and citations of authorities in reply to Prof. Winchell's objections to the theory of excessive moisture, cover but this one point, viz., that trees will not grow on lands saturated with stagnant water, and leave unproved the other and most important statement that they will not grow there when the ground has become dry. Should this statement be true, we ought to find extensive prairies in many regions where prairies are rare; for instance, along our low Atlantic coast, and the delta of the Mississippi River. Especially ought we to expect to find such tracts along the Amazon, instead of finding there the densest forests on the globe.

Long ago, in the American Journal of Science, Prof. Dana, in writing on the origin of prairies, gave the results of his own observations made in the Mohawk valley, and cited observations made by Prof. Verrill in Maine and Labrador. In this article it is stated that in Maine the bottoms of the lakes are, near the shores, composed of black, soft, vegetable mud of great depth; and though sedges and rushes are found growing at the water's edge, various kinds of trees approach very near the shore, growing even where the supporting soil is soft and wet. In cases where lakes and bogs have been drained, although grasses and sedges may get the mastery the first year or two, forest trees afterward gain the ascendency and keep it. In Labrador, trees were found growing in peat bogs, in the very borders of lakes and pools of stagnant waters. If trees will grow in stagnant marshes and on peat bogs in Maine and Labrador and are not found growing in similar situations in the Mississippi Valley, some other explanation of the fact must be sought than the chemical nature or the fineness of the soil.

But I believe that even in the Mississippi Valley we shall have no difficulty in finding luxuriant forests in situations where, according to Prof. Lesquereux, we ought to find only prairies; nor difficulty in finding prairies where we should be led to expect to find abundant timber. The soil of the Mississippi flood-plain has been deposited as in the case of other large rivers. In some

places strong currents have washed together coarse sands and gravels; in others, where the water has had a gentle movement, it has deposited only the finest sediment; the greater portion of the bottoms, however, consists, as we might expect, of a mixture of these materials, enriched by the humus from decaying vegetation. There has been no lack of opportunities for the formation of swamps in these bottoms, which are frequently from four to eight miles or more in width. Nevertheless, on these bottom lands, formed to a great extent in the way described by Prof. Lesquereux, and much more recently than can be claimed for the higher prairies, we find the heaviest growth of timber and the greatest proportion of timber land.

In the southern part of the State, where upland prairies do not exist, the flood-plain is clothed with the densest growth of forest trees; and this almost irrespective of the character of the soil. In Alexander county, for instance, as stated in the Report of the Illinois State Geological Survey, "the bottom lands are generally flat and are interspersed with cypress ponds and marshes." The higher bottoms are said to be heavily timbered with various kinds of trees. "The swampy lands are characterized by the growth of the cypress, sweet gum, tupelo gum, cottonwood, pecan, willow, etc." We find analogous statements made concerning the counties lying northward along the Mississippi, until we reached the region where prairies begin to appear on the highlands. Then small prairies appear also on the flood-plain; but these are likely to occupy the higher grounds and the dense timber growth the low wet lands. We learn of heavy forests on soil described as a deep sandy loam, highly charged with humus; and on similar soils, bottom prairies. Nor is it unusual along the Mississippi and other rivers of Illinois to find bottom prairies whose soil contains a large proportion of sand and gravel. In the report of the geology of Jo Daviess county, the most northern river county of the State, we find this statement: "In the western part of the township of Hanover, bottom timber-land, alluvial grass-land, and a table-land, high and dry, exhibit all the characteristics of the ordinary Mississippi alluvial bottoms. Farther down in Carroll county this bottom changes into the broad, well-known sand prairie, an old, broadly extended, glittering Mississippi sand-bar." Such quotations from many independent observers could be multiplied indefinitely to show: 1st. That even marshes may be timber-grown; 2d. That the distribution of forest lands bears

no relation to that of ancient swamps; 3d. That sandy and gravelly bars and dams are frequently devoid of trees.

But even if we should grant all that Prof. Lesquereux claims respecting the inability of trees to thrive in soils that have accumulated in swamps, I cannot admit that his theory will explain the occurrence of prairies over a large part of Illinois and Iowa. However it may be in the case of Wisconsin and Minnesota, it is evident that the soil of the prairies of at least large portions of the former States has not been formed in marshes. We have, it is true, evidence that at some period since the epoch of the Drift the surface of the whole country has been depressed much below its present level. We find everywhere along the Mississippi River and at many points along the Illinois an extensive deposit capping the bluffs and sometimes extending out into the ancient river bed. This deposit is sometimes very thick near the bluffs, but thins rapidly towards the highlands and soon disappears. This deposit, called in the Report of the Illinois Survey the Loess, must have been thrown down during the Champlain epoch, when a series of lakes occupied the broad valleys of our rivers, filling them, no doubt, to their brim, and even extending over portions of the surrounding country. But that the prairie soil or subsoil was then deposited, or that there has been any general submergence since, we have, I think, no sufficient reason for believing.

On the contrary there are many serious objections that might be urged against the idea that the prairie soil has been deposited in lakes and stagnant swamps; some of which I shall here present.

1. According to Lesquereux, timber is found growing along dams cutting off from the body of the lake the bog that is to become prairie. Do we find our Illinois forests on the higher lands? That they sometimes so occur, especially in northern Illinois, will not be denied; but in such cases, instead of being long stretches of timber, bordering and separating prairies, they are generally small, rounded clumps. Much the greater part of the wooded country in Illinois is found along the river bluffs and on the bottom lands.

2. If the prairie soil is a lacustrine deposit, it ought to be free from such coarse materials as are found in the Drift. In swamps whose soil has been produced by the decay of vegetation and from sediment washed in by gently flowing waters, there is scarcely a possibility for coarse rocks and boulders to occur. The discovery of a large Drift boulder in the alluvium of the Missis

sippi river, in Whiteside county, was regarded by the observer as so extraordinary as to call for a special explanation. And yet on the prairies of Illinois, frequently lying on the surface and in the soil at all depths, are found numerous boulders of granite, syenite and trap rocks. On the surface they are found scattered from the hilltops to the very borders of the sloughs; and hidden in the ground they frequently prove a nuisance to the cultivator of the soil. Their presence in such situations cannot be reconciled with the notion that the soil is a lacustrine deposit.

3. The general absence of fossils in the soil and subsoil of the high prairie lands is opposed to Lesquereux's theory. In the Loess we find abundant fossils of land and fresh water shells. Such remains, too, sometimes occur in the deposits of the sloughs and marshes on the prairies; but these deposits are of later date than the soil of the higher grounds, and have frequently been formed as described by Lesquereux. If the prairie soil had been formed as he supposes, it would have afforded the most favorable conditions for the preservation of animal and vegetable organisms. "At a depth of from one to three feet the mosses, confervæ, and charas form a thick carpet which hardens, becomes consistent, like a kind of felt, and floating about six inches above the bottom, is nearly thick enough to sustain the weight of a man. This carpet is pierced with holes where fishes pass to and fro; and the bottom under it is that fine impalpable clay, evidently a residue of the decomposition of its plants." We ought then almost anywhere on these prairies, to find insect and leaf beds as rich as those of Œningen. But where now are those aquatic insects that people such waters; those land and fresh water mollusks; those numerous cray-fishes; those leaves of plants that must have been buried there? Where are now those little fishes that passed to and fro through the holes in that mossy carpet? So far as the writer knows, no such remains have been found.

4. The theory urged by the distinguished botanist requires us to suppose that these prairies have undergone a greater amount of denudation than would have been possible under the conditions supposed. He admits that the prairies must originally have been horizontal, and attempts to explain their present undulating character by supposing that where we now find broad and level sloughs, the soil has been removed by the gentle movement of water on its way to lower levels. The hills, however, rise frequently many feet, sometimes perhaps a hundred, above the level of

the low grounds, and these may be many rods in width. The theory under consideration requires us to believe that in such cases an enormous amount of material has been removed. And yet it is questionable whether, under such circumstances, the soil would be removed as rapidly as it would accumulate through the decay of vegetation. For if the surface were as level as we must suppose it was, and as it frequently is in these sloughs, the water must have moved so slowly as to carry little sediment along with it; and as the water passed through the tangled grasses, rushes and sedges, even this little would have been filtered out.

Indeed, the cause assigned for the uneven surface of the prairies is one that tends to produce the very opposite effect, that of removing any inequalities of the surface that might have at first existed. For the water running down the hillsides would have carried with it some soil. On reaching the level slough its velocity would have been checked and a large part of its burden deposited. That this has occurred, rather than the contrary phenomenon, is plainly shown by the fact that the alluvium is much deeper in the sloughs than on the tops and sides of the hills.

5. The theory referred to requires us to ascribe to the alluvial deposits of the hypothetical lakes an undue thickness. For, since the peculiar fine soil of the prairies is found on the hilltops, as well as in the valleys between; it follows that, if the surface were once level, the lacustrine deposit of soil must have been of a thickness at least equal to the height of the hilltops above the lowest point to which the soil extends in the valleys. We must then believe that the deposit was perhaps a hundred feet in depth; and since the valleys have been scooped out of this, we might expect to find the hills composed entirely of the lacustrine sediment—rich, black, prairie soil from ten to one hundred feet in depth. On the contrary the soil is comparatively thin on the hilltops, very deep in the valleys.

The valleys have been excavated from the Drift formation; and the general contour of the prairies must have been determined before the prairie soil was formed, under whatever conditions it may have resulted. That some portions of the prairies, especially those bordering our great lakes and some of our rivers, have originally been swamps cannot be doubted; but that they are destitute of trees must be attributed to other causes, the absence of which in other localities permits the growth of trees alike on the finest or the coarsest, the sweetest or the sourest soil.

METHODS OF LABELING IN OÖLOGICAL COLLECTIONS.

BY W. H. BALLOU.

THE study of the eggs of birds, which has recently taken such impetus as to give it a recognized position in the science of ornithology, is at present in a condition deplorable indeed, from its broad deficiencies in the matter of labeling. Taking up an egg, in size no greater than a robin's, we find plentifully scattered over its surface an advertisement large enough to adorn a newspaper column, spreading forth the fact apparently of great moment to the scientific world, that Mr. So-and-so was the fortunate collector of the egg, that it was collected on such and such a day, month and year, that it is a certain number in a standard catalogue, and numbers so-and-so in So-and-so's collection. Examining European eggs in countries where the science was old when America was new, specimens are often found with a semicircular band of paper, or with a square label pasted on them with the scientific name written in ink or printed. Where the names are long, it is often a matter of speculation as to which occupies the greater space, the egg or the name. It is a shocking disgrace to European oölogy, equal in some respects to the eminently unscientific usages of our own oölogists. It is astonishing that during these centuries of existence that the science has attained so little eminence, and has remained so deficient in so small a matter as labeling, leaving out other points of greater and of less moment. It has heights and depths which it may attain to, and which will undoubtedly be arrived at before many years. Its devotees, at present, seem to consist mainly of a class of persons whose only interest is concentrated in the knowledge of having a "collection" of eggs and in discovering species yet unknown. The latter though of value to oölogy are used to build up ornithology, and to that science is the credit of the discovery given.

In consideration of some of the above facts it has been a subject of much study on the part of myself and undoubtedly others as to what remedies may be successfully applied to so great an evil as the present labeling system. The problem is not without its difficulties of solution. Many and varied were the experiments tried, which sometimes met with success in part, but on the whole are causes of grave errors. In each experiment some one was sure to so disarrange the eggs as to make it impossible to identify them. A leading difficulty was also found when

the collector possessed one or more sets of the same kind, or large quantities of eggs of the same species, as in the case of water-birds. It is still worse, when each egg or set of eggs of the same kind was obtained on the same day under different circumstances and in different localities. Here there should have been a separate label in each case; but what collector is there that has been able or disposed to furnish one, or if he has done so, who at his death will be able to decipher them? A catalogue of continued difficulties rises before the collector; labels pasted, or markings written on the egg, deface portions of its natural colorings. Slender shells often crumble in the hand while attempting to inscribe a written narrative thereon. Eggs are exchanged, passed into a new collector's hand, who rubs away at the original marking, and deprives it of its natural luster and finish to make way for a new and more extended announcement. Drawbacks of these descriptions are sufficient to place any science below par and cast suspicion on its accuracy.

But at last an expedient has been determined upon which, if followed, seems to cover the entire ground and to keep each individual egg forever in a condition that will enable one to preserve an accurate record of it.

Having occasion during the past year to make an arrangement of the collection of oölogy in a certain Academy of Sciences in the west, my attention was more than ever drawn to the absolute necessity of having a different system of labeling from the one I employed there, especially in so large an institution where duplicate eggs are stored away by the thousand with no distinction whatever. Soon after obtaining additions to my own collection of eggs, some of which required mending, I was attracted by the wonderful adhesive force of "coaguline"[1] in cementing shells together. Following out the line of thought presented at the time, I was enabled to perfect a system of labeling which is essentially described here:

Slips of paper are to be prepared in triangular form, or at least to have one portion tapering to a point as in Fig. 1. The slips

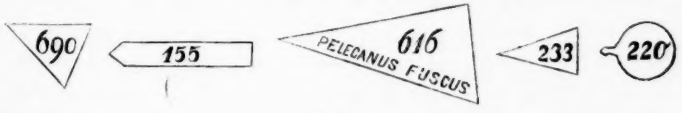

FIG. 1.

[1] A preparation sold by druggists.

can be cut in sizes varying with the dimensions of the eggs, or the amount of writing intended to be placed upon them. Having made the necessary record, the very tip of the label may be moistened with coaguline and fastened to the egg as in Fig. 2. It should be placed on the border of the drilled hole on the side, so that both may occupy as little space as possible. Almost the entire surface of the egg is now in a condition for examination. The advantages of such a label are seen at once. Both sides may be written upon. They may be used as handles by which to hold the egg for examination, thus saving many eggs from being crushed. They may be made sufficiently large to contain all necessary writing, or small enough to suit the taste. They may be taken off at any time by simply dipping the cemented portion into warm water; and it is often desirable to do this, especially in exchanges. There is no possible danger of their being torn off when they are handled with the care usually bestowed on eggs.

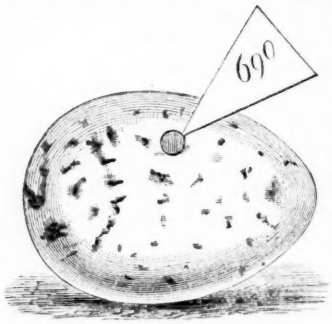

FIG. 2.

A practical use of the above method is convincing proof of its efficiency.

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NOTES ON INDIAN MANNERS AND CUSTOMS.

BY DR. EDWARD PALMER.

The Navajoes in the presence of death.—In 1869, Colonel Dodd, agent of the Navajo Agency, was very sick, and Barboncito, the head chief, though quite unwell himself, went to see him. After gazing intently upon the Colonel for a few minutes, and shaking hands, the chief said in Navajo, "I wish you a good journey," and left the room weeping. When the agent was dead and laid out, all the Indians came to look on him whom they had loved so well, though it is their custom never to look upon the dead. At the funeral Barboncito expressed a desire to go with the Colonel, but afterwards recovered from his sickness.

A Navajo Indian being sick, his friends took away his ticket entitling him to food at the Agency, gave him an old blanket and

some water, and left him to die. No coaxing or threats of the agent could induce them to go near the corpse, and it was buried by the men of the Agency. The custom is, upon the death of a member of the tribe, to block up the door of the hut containing the corpse and never again to visit the spot through fear of evil spirits. They sometimes kill the best horse of the deceased and eat it at a funeral feast.

Navajo women gambling.—The Navajo women are fond of gambling, which they practice in the following manner. A square, marked off and surrounded by small stones, is divided into four equal parts, having ten stones to each part. A large flat stone is placed in the centre, and a stake four or five feet long is firmly set at each corner of the space. A blanket is stretched over the square and fastened to the stakes, but not to shade the players, as will be seen. At each of the four divisions of the square a player is seated on the ground, while young and old stand or sit around to enjoy the sport. Three short, flat, smooth pieces of wood, black on one side and white on the other, are used to play the game. The player takes the sticks in the right hand like jack-straws, and, bringing one end forcibly upon the stone, sends them up against the blanket which causes them to fall into the square. If three black sides are up, it counts five, if white, ten. If one white and two blacks are up it counts two, if two whites and one black, three. Each player keeps tally by scratching a notch on a stick with a stone. They are very fond of the game, manifest great spirit in playing, and will frequently stake all they have upon it.

Apache playing cards.—The Apaches now use in gambling a pack of cards similar in shape and ornamentation to those used among civilized people. They are made of horse hide, tanned separately, and painted with the juices of wild plants. Like the Mexicans these Indians will sit upon the ground night and day, and in all weathers, gambling with an excitement amounting almost to frenzy, and stopping only when the stakes or their strength is exhausted.

An Apache Medicine-man.—The medicine-man of the Ararypa band of Apaches is called Tseiland. He wears a very noted hat which could not be purchased at any price, owing to the belief that it came from the sun, and that to part with it would gain the sun's displeasure. The hat is made of buckskin and ornamented

with turkey and hawk feathers, buttons, shells, and turquois. It is never off his head, night or day, excepting for a short time when he is washing his hair or combing it. The fingers of an Apache answer for a comb, being drawn through the hair, while the head is bent a little to one side.

Apache rat-catchers.—The Apaches, old and young, hunt rats, with long crooked sticks, no hole being too deep or winding, no brush too thick or thorny for them. The entire animal, just as caught, is roasted, and before half cooked is devoured, entrails and all. It is amusing to see a party of young Apaches returning from a hunt, with rats dangling at their belts as thickly as they can hang. No dyspepsia disturbs these juvenile rat-catchers, no cat or terrier can equal them in dexterity.

Apache marriage.—After the female consents to be a bride, the bridegroom must get the permission of her father, who at the same time names the articles to be given in exchange for her. The groom delivers the goods and takes his bride, not to his house, however, for she must build and equip that, and procure a great portion of the food for the family. The life of an Indian wife is one of incessant and severe drudgery. Adultery is considered a great crime on the part of the wife, but public sentiment does not condemn the husband. As soon as the crime is proved, the unfortunate female is captured and her nose cut off close to her face, leaving a horrible wound which is not healed for a long time. For months some wear rags around their faces to hide the scar, and they conceal themselves from strangers.

Visit to the Moqua Indians.—In May, 1869, in company with the Rev. Vincent Colyer, I visited the Moqua Indians. One night, when camping near one of their towns, we wished some corn for our horses. The Governor being informed of the fact mounted the top of his house and called aloud for corn. A movement was soon discernible, house-tops, windows, and doors were occupied by listeners. The Governor repeated his call several times. Soon from every quarter corn was brought in flat baskets, until more than enough was procured, for which we were to pay nothing, but Mr. Colyer gave them some flannel. They were surprised to see us giving corn to our horses, because it is raised with so much difficulty that they use it only for their own consumption.

The governors of the Moqua towns are accustomed to mount

their house tops at night and to give instructions to the people regarding the labors of the following day. The night before we left the town of Uriba, one of these harangues was made, and we were informed that the governor had instructed his people to go out early in the morning and kill off the jack rabbits, which would otherwise eat up all their corn. Early next morning all the men turned out, accompanied by the women, whose business it was to take care of the game. Rabbits are an important article of food with these Indians, and the skins cut up into strips are made into cloaks and beds. The implement used in capturing them is the boomerang, which is shied at the legs of the animal. The captain of the same town once ordered the people out to capture the rats in the corn-field.

The Governor of Uriba invited Mr. Colyer, Lieut. Krouse, and myself, to dine with him in his three-story house. He received us cordially, showing us a silver headed ebony cane, the gift of President Lincoln. Dinner being announced, a blanket was spread on the floor, and upon it were arranged dishes of dried peaches, a good supply of mutton, and a large basket of corn-cakes as blue as indigo, made from the meal of the blue corn. There were also some dishes filled with a sweet liquid made by dissolving the roasted center of the agave plant in water; coffee completed the bill of fare. There were neither plates, knives, forks, spoons, or napkins, but the dinner looked clean, and so did everything else about the house. The bread answers for both plate and spoon. You take a small piece, lay a fragment of mutton and some peaches upon it, or a little of the sweet liquid and bolt the mass, spoon and all. This dinner, though prepared and cooked by Indians, tasted better than many a meal eaten by us in border settlements, cooked by whites. After dinner we took leave of the Governor with many thanks.

Eating customs in several tribes.—The Cocopah Indians of Arizona will not eat pork, though they have acquired a taste for salt beef. They are very fond of fish and will eat them at any time. They will not eat shell-fish of any kind. The Mono Lake Indians of California, eat soup made of angle-worms thickened with grass-seed flour. They also gather bats from caves and roast them in hot ashes without removing either feathers or entrails. Wasp nests are roasted and eaten; the more young they contain the better are they relished. The young Indians, in order to find the

nests, capture a wasp, place a small straw in the abdomen, light it, and let the insect go, they then watch its flight, follow it, and secure the nest. The Miama Indians were very fond of a dish prepared by boiling the roots of the yellow lily, *Lilium canadense*, with meat. In the fall the roots, often two inches in diameter, are gathered; they taste very much like green corn. These Indians also eat otter oil cooked in soup, and consider it very nutritious.

The Cheyennes and Arapahoes consider dog-meat a superb dish, and when they wish to honor a guest especially, they kill the fattest dog and roast it; great offence is given if the guest eat not bountifully of the chosen dish. They also eat poisoned wolves in the Buffalo country. The white men kill the buffaloes for their hides, tallow, tongues, and some of the best portions of the meat. The tongues bring a high price. The rest of the carcass is then poisoned with strychnine. The wolves eat the meat and their intestines become inflamed, producing death. The Indians remove the viscera and eat the remaining portions of the wolf. On Cow Creek in Kansas, in 1865, I saw the carcasses of hundreds of wolves that had been thus eaten.

The Wichita and Comanche Indians will not eat fish that have scales, but are fond of those that have no scales; they catch both kinds, and sell those which they do not like to the whites.

The Apaches kill the beeves issued to them in the following manner: They divide themselves into parties; a lasso is cast around the animal's horns and he is thrown to the ground. His throat being cut, a number of the Indians mount the body, still alive, while the others proceed to cut up the animal in spite of his plunging. I saw on one occasion a party cutting out the ribs, another removing the viscera, when the beast with a fearful bellow, extricated himself from the piles of Indians holding his legs, dealt one man a terrible blow in the face, and gored another in the stomach. But they rushed like wolves on their prey and soon had the quivering meat dangling at their horses sides, the squaws carrying off every morsel that was left. In this operation the strong have no respect for the weak, animals that have been sometime dead are not rejected, and every part of the carcass is devoured. They greatly prefer mule and horse flesh. It is roasted half done, all standing around and cutting off slices as soon as it is thoroughly warmed. They will not eat anything, however, that has been killed by lightning.

The Navajoes dislike pork, but they beg for it to soften leather. They do not eat bear's meat, and to call a man a bear is a term of great reproach. They do not eat eggs for fear that they will hatch in their stomachs. Turkeys also are rejected because they think that bad white men, after death, are changed into that bird. The transformation occurring beneath the water, the white markings in the feathers of the turkeys is due to the white foam. These Indians capture the turkeys and sell them to the whites.

While staying at the Navajo Agency I poisoned a number of mice for specimens and laid them away until an opportunity offered for skinning them; but hardly was my back turned, before they were stolen and cooked.

Prairie dogs are a favorite article of diet with the Navajoes. The animals are caught thus: A piece of glass is fixed in the split end of a stick which is so placed as to throw the light into the hole. The animal as he amuses himself at the glass is a good mark for the Indian. Another method is to place a large stone above the hole with a string attached; when the prairie dog goes off to feed, the string is pulled and the stone dropped over the mouth of the den. The dog returning and finding his door blocked up, commences to dig around the stone, when he is quickly pinioned by the hunter's arrow. The Navajoes mix their meal or flour with water, and pour the batter into a hole made in hot ashes where it is left to bake.

——:o:——

RECENT LITERATURE.

A VALUABLE WORK ON THE HONEY-BEE.[1]—This little French work before us is worthy of translation, so as to make its contents accessible to that large and growing class of bee-keepers who have mastered the technology of bee-keeping as practiced in this country. While it is eminently scientific, it is not above the comprehension of an ordinary reader. We notice particularly the full discussion of the embryology and anatomy of the drones, queens and workers, a subject not usually treated as fully as it deserves. The enemies and diseases to which this wonderful insect is subject are also described and the former also figured. The geographical distribution of the three domestic forms of the

[1] *Les Abeilles, Organes et Fonctions Éducation et Produits Miel et Cire.* Par MAURICE GIRARD, ancien President de la Société entomologique de France, etc. Avec une planche coloriée et trente figures dans le texte. 12mo, VIII, pp. 280. Paris, 1878. J. B. Baillière et fils.

bee are given, viz: the common black of Central Europe, Italian and the Egyptian, which is also found in Asia Minor, and supposed to be the species spoken of in the Bible. The systematic position and relations of the creature also receive attention.

In describing the apparatus used in their management, we notice that most of it is such as has been thrown aside and superseded in this country by simpler or more effective contrivances. The "queen yard" as used by Quinby and improved by Mrs. Farnham, "queen cages," "breeding hives" are not mentioned. This fact taken with what the editors saw at the Centennial Exposition in the way of apparatus, from England principally, leads him to conclude that American bee-keepers are far ahead of their European brethren in the perfection of appliances to render the pursuit of apiculture profitable.

BREHM'S ANIMAL LIFE.[1]—This volume completes the account of the Carnivora, and treats of the Insectivora, Rodentia, Edentata,

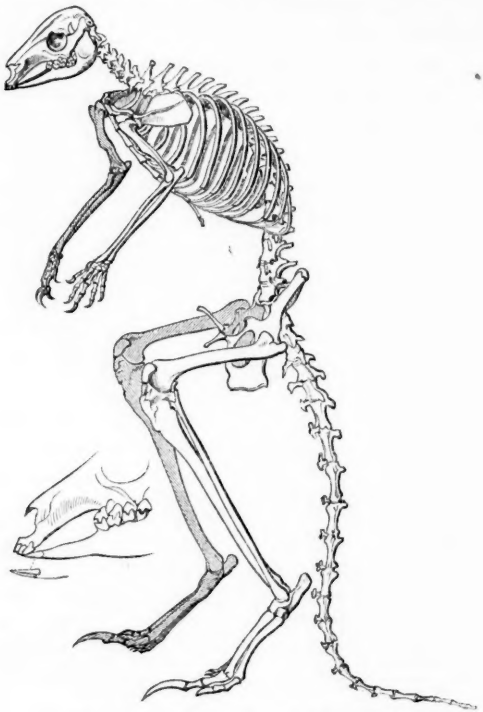

FIG. 1. SKELETON OF THE KANGAROO.

[1] *Brehm's Thierleben.* Band 2. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflager. Leipzic, 1877. 8vo, pp. 628. B. Westerman & Co. New York.

Marsupialia and Didelphia, so that some of the most interesting of all the mammals are described by word and pencil. The vol-

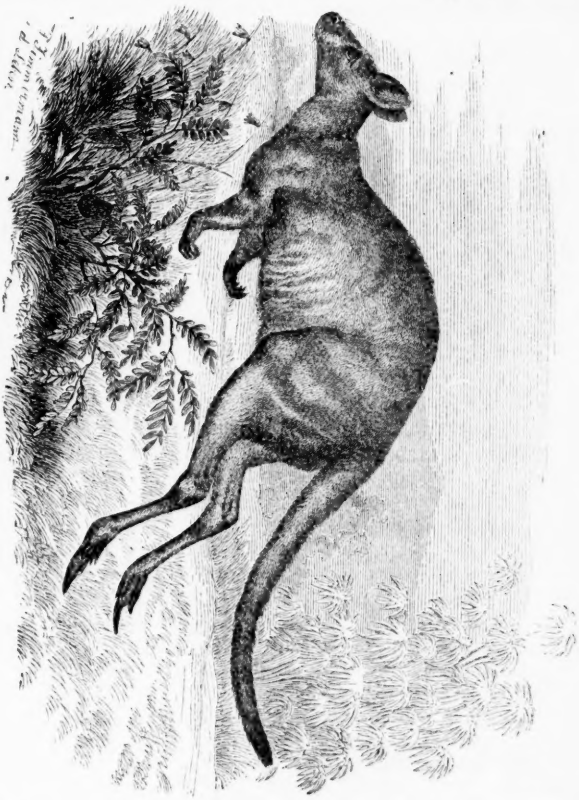

FIG. 2. KANGAROO (*Macropus thetidis*).

ume is rich in full page illustrations, containing fifteen drawn with

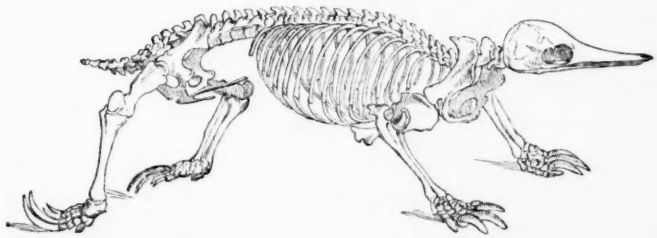

FIG. 3. SKELETON OF *Echidna hystrix*.

great apparent accuracy and skill, comprising portraits in various

attitudes, with the appropriate surrounding features, or environment, of the crag and long-lipped bear, hyæna, ichneumon, coati, bobak, mara or cavy (*C. patagonica*), fish otter, field mouse, porcupine, with a very spirited drawing of a drove of capybaras, and a group of kangaroos, as well as the singular Oryctopus of the Cape

Fig. 4. Spiny Echidna (*E. hystrix*).

of Good Hope, and the two-toed sloth (*Cholœpus didactylus*). The marsupials are illustrated, with many excellent drawings, including among others pictures of the Thylacinus, tasmanian devil, Dasyurus, opossum, kangaroo rat, wombat, koala, &c., &c. Through the kindness of the publishers we are able to reproduce the skeleton

of the kangaroo, and a drawing by Zimmermann of *Macropus thetidis* (one-eighth natural size). The Monotremes are also well drawn, as will be seen by the accompanying figures of the *Echidna hystrix*, and its skeleton; the pair of duck-bills is well drawn.

The bears are well figured with one or two exceptions. We are not well suited with the group of prairie dogs, and in the account of them more perhaps might have been quoted from American authors, than from passing German travelers. The Egyptian Jerboa is well drawn and described at length, while no mention is made of our American jumping mouse or *Meriones hudsonicus*, and our characteristic jackass rabbit is not mentioned, much less figured. Still the work is of great value to the general reader and student of nature, as well as the special zoölogist, as being a treasury of excellent illustrations and descriptions of the habits of the most striking animals of the globe; and we hope that the work will meet with a good sale in this country, where we are too much inclined to study American species alone. The price of the work in this country is 40 cents a part or about $5.00 a volume, which is certainly very reasonable.

RECENT BOOKS AND PAMPHLETS.—The Development of the Cranial Nerves in the Chick. By A. Milnes Marshall. (From Quart. Journ. Microscopical Science) 1877. 8vo, pp. 33. Two plates.

Brehm's Thierleben. Leipzig, 1878. New York, B. Westerman & Co. Band 7. Parts 1-10. 40 cts a part.

Ferns of North America. By Prof. D. C. Eaton. Salem, S. E. Cassino. 4to. Parts 2 and 3. $1.00.

Collembola borealia. Nordiska Collembola, beskrifna af Tycho Tullberg. (Ofversigt af Kongl. Vetenskaps Akademiens Förhandlingar, 1876). Stockholm. 8vo, pp. 19. 4 plates.

Estudios sobre las Deformaciones, Enfermedades y Enemigos del Arbol de cafe en Venezuela. Por. A. Ernst. Caracas, 1878. 8vo, pp. 24.

Note sur des Perforations, observées dans deux Morceaux de Bois fossile. Note sur une aranéide fossile des Terrains tertiaires d'aix. Par. Charles Brogniart. (Extrait des Annales de le Société Entomologique de France). Paris, 1877. 8vo, pp. 9.

Notes on the Herpetology of Dakota and Montana. By Drs. Elliott Coues and H. C. Yarrow. (Extracted from the Bulletin of Hayden's U. S. Geological Survey of the Territories, iv, No. 1.) Washington, 1878. 8vo, pp. 48.

Nomenclature in Zoölogy and Botany. A report to the American Association Adv. Science. By W. H. Dall. Salem, 1877. 8vo, pp. 56.

Pacific Coast Lepidopteri, No. 24. Notes on the genus Colias, with descriptions of some apparently new Forms. By Henry Edwards. (From the Proceedings of the California Academy of Sciences. February 5, 1877.) 8vo, pp. 11.

Annual Report of the Entomological Society of Ontario for the year 1877. By W. Saunders, C. J. S. Bethune, B. Gott and J. Williams. Toronto, 1877. 8vo, pp. 59.

Beiträge zur Kenntniss der Anatomie von Chiton. 8vo, pp. 27. Ueber den Begriff der Segmente bei Wirbelthieren und Wirbellosen, nebst Bemerkungen über die Wirbel. Säule des Menschen, 1877. 8vo, pp. 4.

Report on the Geographical and Geological Survey of the Rocky Mountain Region. By J. W. Powell, Washington, 1877. 8vo, pp. 19.

Notice of the Butterflies collected by Dr. Palmer in the arid regions of southern Utah and northern Arizona during the summer of 1877. By S. H. Scudder (Extracted from the Bulletin of Hayden's U. S. Geological Survey of the Territories. Vol. IV, No. 1). Washington, 1878. 8vo, pp. 6.

Notes on some Jurassic Fossils, collected by Mr. G. M. Dawson, in the Coast Range of British Columbia. By J. F. Whiteaves, Montreal, 1878. 8vo, pp. 10.

Traveling notes on the Surface Geology of the Pacific Slope. By G. M. Dawson. (From the Canadian Naturalist, viii. No. 7.) February, 1878. 8vo, pp. 11.

GENERAL NOTES.

BOTANY.

INFLUENCE OF MOISTURE ON VEGETATION.—Carefully conducted experiments (published by Paul Sorauer in the *Botanische Zeitung*, Jan., 1878) with spring barley yielded the following results: In dry air branching was greater than in moist, the mean figures standing at 2.77 and 2.37 respectively; length of leaves was greater in moist air in the ratio of 21.37 to 21.07, but the breadth was less (6.74 to 7.33); a moist atmosphere is more favorable to length of leaf-sheath in the proportion of 9.26 to 8.18, to growth of the principal stem (13.5 to 11.5) and to root development (26.8 to 23.9). It was found that the epidermal cells of the leaves were more numerous and broader, the cells between the stomates shorter, and the stomates themselves shorter in dry air. Also, that leaves developing in a moist atmosphere have comparatively fewer stomates per millemetre of length. The question is worth further working out *apropos* of the relation between the minute structure of organs and their environment.—*Journal of Botany.*

BESSY'S INJURIOUS FUNGI.—This is an essay on the different species of blight or Erysiphei, which live chiefly on the leaves and sometimes on the stems of plants, and attack no less than fifty species of plants of much value in agriculture. The article contains descriptions of all but three species, the descriptions in a few cases being original. Figures of ten species in sufficient detail for their identification accompany the text, which is extracted from the Seventh biennial report of the Iowa Agricultural College.

VARIATIONS IN THE LEAF-SCARS OF SIGILLARIA AND LEPIDODENDRON.—In two papers reprinted from the Annals of the New York Academy of Sciences, Mr. H. L. Fairchild gives some interesting results of studies showing that species of these fossils have been multiplied to too great an extent, from the imperfect nature of the fossils, owing to the great variability of the only characters that can be used by fossil botanists.

REINSCH'S SAPROLEGNIEÆ AND PARASITES IN DESMID CELLS.—While this article from Pringsheim's Yahrbuch contains observations on certain new and very curious low plants, its chief interest to us are the figures and descriptions of sundry cytodes which have the power of penetrating the interior of desmids, and remind us of certain monera described some years ago by Cienkowski under the name of Vampirella. The author, who has just gone to Key West to study the large one-celled algæ, has lately, during a visit to this country, been engaged in a study of the organisms in the Cochituate water of Boston. He found over a hundred species of minute plants and animals in this excellent drinking water.

BOTANICAL NEWS.—In the London *Journal of Botany* M. A. Hartog describes the floral structure and affinities of *Sapotaceæ*. W. P. Hiem discusses a question of botanical nomenclature. C. C. Babington contributes Notes on *Rubi*, and there are several descriptive papers.

At a late meeting of the Linnæan Society, F. Darwin read a paper on the Nutrition of *Drosera rotundifolia*, in which he showed the advantage gained by the plant being fed with meat, and that the capture by the plant of flies is of similar benefit.

Mr. T. Dyer made a brief communication on the so-called "rain-tree" of Moyobamba, North Peru. This tree promises to excite as much interest amongst residents in hot, dry countries as the supposed anti-malarious properties of the fever tree (*Eucalyptus globulus*) had done amongst the inhabitants of hot dry ones. From information received through Mr. Spence, it seemed probable that the rain tree was *Pithecolobium saman*, and the so-called "rain" the fluid excretions of homopterous insects which fed on the juices of the foliage; other trees, however might become rain trees, and the phenomena were comparable to the production of honey dew from the lime, etc., by the agency of Aphides.

ZOÖLOGY.[1]

THE HOMOLOGY OF THE CHEVRON BONES.—The chevron bones of *Reptilia* and *Mammalia* have been regarded as the homologues on the inferior side of the vertebral centrum, of the neural arch on the superior side. However this may be true of fishes, it appears not to be the case in the two classes named, in an exact sense. I have recently determined the fact that the basal portions of the chevron bones are continued throughout the greater part of the vertebral column in the Permian genera *Clepsydrops*, *Metarmasaurus* and *Epicordylus*, forming intervertebral elements to which I have given the name of intercentra. This intercentrum nearly replaces the centrum in *Trimerorachis*, and does so completely in *Rhachitomus*, both Permian genera. In *Cricotus* the intercentra are subequally developed with the centra, producing the curious appearance of two kinds of vertebral bodies alternating with each other, the true centra only bearing neural arches, and the intercentra bearing chevrons in the caudal region. It appears then that the chevron bones are the remnants in the caudal vertebræ of a structure once general throughout the column of air-breathing *Vertebrata*, but which has been replaced in them in the dorsal and lumbar regions, by the true centrum. The free elements of the cervical series of some reptiles are probably the same.—*E. D. Cope.*

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

NOTES ON THE RECENTLY DESCRIBED MONOTREMES.—With the appearance of Gervais' *Osteographie des Monotremes Vivant et Fossiles*,[1] zoölogists are again reminded that not all that is to be known in regard to beings now living has yet been chronicled. This memoir follows close upon Mr. E. P. Ramsay's papers read to the Linnæan Society of New South Wales. In the two we get materials which very greatly enlarge our knowledge of these curious porcupine-like animals with anteater-like tongues, of which the best and longest known example is *Echidna hystrix*. Mr. Ramsay describes a form apparently belonging to the old genus, which he calls, *E. lawesii*, from Port Moresby, New Guinea; the number of nails being the same as in the old species, viz: five, both in front and behind; but I find upon comparing a skin of *E. hystrix* with his drawings that the inner nail is apparently somewhat longer in his species. He observes that the species "is distinguished chiefly by the long cylindrical form of the quills, and the stiff, flat hair-like bristles on the face." It is unfortunate that the describer has not ascertained the number of palatal corneous processes on the tongue and also the cranial and osteological differences which would have done much to establish the legitimacy of the species.

The new *Acanthoglossus bruijnii*, monographed by Prof. Gervais, measures about 19 inches in length, or about one-half longer than the species hitherto described. The occiptal condyles are much more prominent backwards than in *Echidna*, and the beak is about three times as long as in the latter, and curved slightly downwards. On the palatal membrane there are a series of conical corneous processes depending into the oral cavity; these are in five transverse rows of from four to eleven, at the posterior nareal extremity; then in twos, then a single one, then a pair, then in symmetrical clusters with transverse toothed borders. There are seventeen of these rows, individual and clusters of corneous retroverted processes in *Acanthoglossus*. Gervais says that in *Echidna* there never was more than seven of these series; Owen corroborates this, saying (*Anatomy of Vertebrates* vol. iii, p. 385), "The palate is armed with six or seven transverse rows of strong, sharp, but short retroverted spines." The posteriorly convergent lines of spines on the basal portion of the tongue in *Acanthoglossus* furnished a further distinction from *Echidna* in which these are in a confused cluster. The four transverse fimbriated lamellæ in front of this cluster of spines, as in *Echidna*, are absent. The tongue itself is about two and a-half times longer than in the old species, the basal two-thirds cylindrical, tapering and vermiform, but not acuminate at the tip, being rounded at the end and grooved on the dorsal face for about a third of its length. In the groove there are three longitudinal rows of backwardly directed spines, a median and two lateral.

[1] Bertrand. Paris, 1877-78,

The cerebral portion of the brain of *Acanthoglossus bruijnii* is more pointed, while that of *Echidna*[1] is more obtuse and somewhat square in outline anteriorly when viewed from above. The cerebral convolutions of the former are more numerous and complex than in the latter, where they are relatively few and simple.

The interclavicular bone supports a strong median carina much more prominent than in *Echidna*. The xiphoid segments of the sternum in *Acanthoglossus* are ossified and not cartilaginous. The phalanges of the manus and pes of both genera may be represented as follows:—

Acanthoglossus, manus 1,3,3,3,2; pes 1.3,3,3,2; ungues $\frac{3}{3}$.
Echidna, " 2,3,3,3,3; pes 2,3,3,3,3; " $\frac{5}{5}$.

The foregoing characters which are the principal ones, justify, it would seem beyond all doubt, the propriety of erecting the large New Guinea species into a separate genus as Gervais has done. Knowing, as we do, the exceedingly trivial and insufficient morphological differences which have served for the establishment of new genera and species, we can readily appreciate such wide differences as are here presented principally in the number of phalanges and nails, as well as perhaps the more important lingual, palatal, cranial and cerebral characters.

The specimens, a male and female, upon which Prof. Gervais has based his genus, were brought by M. Leglaize from the northern part of New Guinea to Paris. They were obtained on the Karon mountains, at a elevation of 3770 feet above sea level. Peters and Doria had previously described the skull of this species and called it *Tachyglossus bruijnii*.[2] The natives call the animal *Nokdiak*.

The known species of monotrematous spiny anteaters are accordingly three, provided *Echidna lawesii* is distinct, which it appears to be from the rather brief and hardly sufficient description of its author; and *E. hystrix* and *E. setosa* are identical. The species then stand as follows in the order of discovery, or rather of characterization:

Echidna hystrix Cuv.
E. lawesii Ramsay.
Acanthoglossus bruijnii Gerv. —*Jno. A. Ryder.*

Prof. P. E. Schulze has discovered the mode of development of the European cavernicolous *Proteus anguinus*. He found one at Adelsberg cave which had laid fifty-six eggs, very similar to those of *Siredon pisciformis*. The *Proteus anguinus* is proved by researches on the ovary of a female from which the eggs were taken to be oviparous.

[1] Nouv. Arch. du Mus. Tom. 5, Pl. 14, fig. 16, p. 248.
[2] Ann. del Mus. Civ. di Sci. Nat. di Genova, tom. IX Dec. 3, 1876.

ANTHROPOLOGY.[1]

MODERN MOUND-BUILDERS.—The Tualati tribe of the Kalapúya stock, living near Forest Grove, the Yampill tribe formerly occupying the valley now called the Grande Ronde Reserve, Yampill and Polk counties, Oregon, and probably all the Kalapúya tribes of the Willámette valley are accustomed to invoke the celestial powers by working themselves violently into a state of utter exhaustion. They roam all night without eating, put themselves into a sweat and leap into a cold river, and scale high mountains to see the sun rise. At the appearance of the god of day they exclaim "O, I am poor! O, I am poor! Make me rich! Make a chief of me!" (The chiefs being the wealthiest men in the tribes.) During the night they throw up with their hands little mounds from three to seven feet long and from twelve to eighteen inches high. Their design is not to conceal property or to bury the dead, but simply to work themselves into a terrible sweat. Their exertions often occupied five nights, the wandering about without food being kept up during the day. These little hillocks are ever after kept in repair. They are erected principally by girls on their first menstruation, by parents who have lost children, by others after bereavements, and by young people generally who thus expected to obtain riches by dreaming of eagles and other good portents. These tamanowus dreams are regarded very highly among them.—*Albert S. Gatschet.*

THE THIRD VOLUME OF CONTRIBUTIONS to North American Ethnology, published by the Department of the Interior, under the editorial charge of Major J. W. Powell, is a positive addition to our ethnological literature, and demonstrates the wisdom of the Smithsonian Institution in committing the publication of its linguistic material to its present hands. The first portion of the volume is by the veteran explorer, Mr. Stephen Powers, first introduced to the literary world by Mr. H. H. Bancroft in his Native Races, and contains an exhaustive account of his researches among the California tribes. The preface contains a rather severe blow at Major Powell's pet theory about the sparseness of Indian population on our continent, the publication of which is a tribute to the fairness of the Major as well as to the independence of Mr. Powers. The latter part of the work is occupied by vocabularies, in the collection of which Major Powell is especially engaged.

ANTHROPOLOGICAL NEWS.—The Davenport, Iowa, *Daily Gazette* of February 16th, contains the description of another carved slate tablet, found in No. 11 of the Cook Farm group, from which the cremation tablet was taken last year. It is about seven and a-half by 12 inches, and has on one surface a human figure sur-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

mounting an image of the sun. In the upper corners are facsimiles of bird-pipes, and in the space between the pipes and the human figure occur various hieroglyphics and the figure of a copper axe. The indefatigable industry of the Davenport archæologists has more than once received the commendation of this journal, they will therefore receive a word of caution with kindness, and not allow themselves to be duped by some wag who will throw discredit upon the discoveries for which we are indebted to Messrs. Gass, Farquharson and others.

The Hon. N. E. Dawson, of Burlington, Ohio, presented to Congress, Feb. 5, a memorial on a Reformed Alphabet and Orthography.

Keith Johnson will publish a compendium of Geography and Travels, one volume to be devoted to each continent. The work will be similar to Von Hellwalds' "Die Erde und ihre Völker."

An Ethnological Museum opened at the Hotel des Invalides, Paris, contains a collection of papier maché warriors of all times and peoples, civilized and uncivilized, in order to exhibit in one view the history of the destructive agencies employed by man.

The Sociétié d' Anthropologie has arranged for a series of "Séances pleniéres internationales des Sciences anthropologiques," in connection with the anthropological exhibit at the Paris Exposition. The paper read will be published in a separate volume.

An Archæological Society has been organized in Japan, called Kobutzio-Kai (Society of Old Things). H. Von Siebold, a member of the Society, has opened a mound at Ozmuri near Jeddo, containing over 5000 articles in stone, bronze, &c. Mr. Siebold says that prior to the Christian era it was customary to surround the grave of a deceased king or queen with a number of attendants, buried alive to the neck. Subsequently clay images took the place of the living subject, and numbers of these images are found in old grave yards.

Mr. Frank Cushing has made a very interesting discovery in connection with the pottery recently sent from the shell heaps of Japan by Prof. Morse. Comparing the marking on this pottery with the ornamentation upon a collection of Aino clothing, previously sent to to the National Museum by Hon. Horace Capron, Mr. Cushing finds the constant recurrence of a conventional pattern on both, to wit, a series of elongated hexagons, joined at their apices, and filled with ornamentation which resembles hatching in a wood cut. This marking is produced on the pottery by the impression of a coarse bast cloth, and on the clothing by embroidery. This seems to indicate that the makers of the shell-heaps were the ancestors of the Ainos.

The following papers on American Anthropology have been noticed: Grönland und seine Bewohner, II., *Ausland*, No. 2; Vom Amazons und Madeira, Dr. Robert Lallement, Gaea, I.; Entdeckung der Statue eines Itza-königs in den ruinen von Chichen. —Itza, *Ausland*, 4.

Attention is called to the following titles of foreign works and papers: The Evolution of Morality, J. Staniland Wake, Trübner; On the Origin of Reason, Max Muller, *Contemp. Rev.*, Feb.; Forest and Field Myths, W. S. Ralston, *id.*; March of an English Generation through Life, *Quart. Review*, Jan.; Evolution of Ceremonial Government, Herbert Spencer, *Popular Science Monthly*, Feb.; Ueber das Alter der Hohlenbewohner des Schaffhauser Juras, Dr. J. Nuesch; Studien zur Völkerbewegung in Mitteleuropa, Dr. Mehlis, *Ausland*, 1877, 52, 1878, 4; Wohnsitze der Deutschen in dem von Tacitus in seiner Germania beschriebenden Lande., Dr. H. Böttger, Stuttgard, 1877; Morphology of the human teeth as related to the races of men, Dr. E. Lambert, reprint in *Amer. Journal*, Oct., 1877; On the subjection of the old by the young, Carus Sterne, *Kosmos*, July, 1877; On the speech of primitive man, Fraulein von Hellwald, *id.*; The origin of the culinary art, Fritz Schultz, *id.*; On the color sense, Hugo Magnus, *id.* Aug.; The Darwinian philosophy, with reference to the problem of will, &c., *id.* Sept.; Color and color sense, Prof. Jäger, *id.*; The language of primitive man, Dr. F. Weeland, *id.* Oct.; Die Forschungen der Kaiserlichen archäologischen commission zu St. Petersburg, II, III, in *Mittheil. d. Anth. Ges. in Wien.*, 7, 8 and 9; Review of Cesnola's "Cyprus," *Academy*, Jan. 19; Cutturgeschichte des Orients unter den Chalifen, Alfred von Kremer (Band II reviewed in *Academy*, Feb. 2, by Stanley Lane Poole); Die Orientalische Frage als cultur Frage, F. von Hellwald, *Ausland*, 1, 2, 3, 4; Languages of farther India and the Indian Archipelago, with map, *Geographical Magazine*, Feb.; Ein Samoa Dorf, *Ausland*, 2; Ueber die Perforation des Penis bei den Malayen, A. B. Mayer, *Mittheilungen Anth. Gesellschaft Wien.* 1877, No. 9.

GEOLOGY AND PALÆONTOLOGY.

The Structure of Coryphodon.—I observe in the issue of "*Nature*," No. 435, p. 340, a note by Prof. O. C. Marsh, stating that I have included in the cast of the olfactory lobes of the brain of *Coryphodon* that of a part of the nasal cavity also. Prof. Marsh fails to point out the qualifying remarks to be found in my descriptions. In the explanation of Plate I of the Proceedings of the American Philosophical Society, 1877, p. 620, I say, "the right bulbus of the olfactory lobe is probably too large above, owing to the want of preservation of the superior wall of the cavity." In my quarto report to Lieut. G. M. Wheeler, in vol. iv., p. 223, of his report to the Chief of Engineers, I remark: "In excavating the matrix from the olfactory chambers some difficulty was experienced in attempting to lay bare the superior and inferior walls, etc. On one side of the bulb this boundary was probably passed through, giving a larger vertical diameter than

the true one." There is no doubt, however, that the greater part of the cast of this region, which I have made, belongs to the olfactory lobes, and for the following reasons: The excavation was conducted with the greatest care, occupying more than two weeks, and the sandy matrix was removed grain by grain. No transverse cribriform plate was found, and no osseous body interrupted the matrix posterior to the anterior extremity of the chamber cast. No longitudinal septum divided the olfactory chambers until the entire thin edge which marks the fundus of the groove in my figure[1] was reached. It is not probable that these structures had been present and been lost. The position of this chamber is much posterior to that of the nasal cavities in *Mammalia* generally, being above the posterior part of the pterygoid plates, instead of between the posterior (tapir) or anterior (hog) regions of the orbits. The septum observed is doubtless that which divides the right and left olfactory lobes. Its sides are smooth as far as the inferior termination of the chamber as figured. I have not followed out its superior extremity owing to the appearance of delicate osseous pieces which may belong to the ethmoturbinal. This is the *first interruption* of the olfactory chamber met with. What the homology of the contents of this space with the olfactory lobes and nerves of later mammalia may be, remains to be ascertained.

Prof. Marsh's last paper on this family is, however, not free from what I should call, were I to use his phraseology, "glaring errors." He denies that the ectocuneiform bone is in contact with the astragalus, which is palpably the case (see my Fig. 12, Pl. LIX, in the volume iv, Palæontology of the U. S. G. G. Survey under Lieut. G. M. Wheeler). He also represents the temporal fossæ as converging towards a sagittal crest behind the orbits, which is not the case. The temporal fossæ are entirely lateral as in *Uintatherium*. See my Plate LII of the work cited. Rather, however, than assume that these are "glaring errors," I await solution of the question as to whether two different genera of *Pantodonta*, i. e., *Bathmodon* and *Coryphodon* are not under consideration.

Prof. Marsh's statement that I am "perfectly familiar" with the contents of a paper published by him in the spring of 1878 is also erroneous. I have not thought it necessary to read that paper, since in his paper of 1877 he merely repeats my own discoveries without credit. My work on this genus commenced in February, 1872, and everything known of it in addition to the subject as left by Hèbert, was added by myself between that date and the spring of 1876. In April of that year I exhibited to the Academy of Natural Sciences of Philadelphia, and a few days after to members of the National Academy at Washington, the cast of the brain of this genus. Prof. Marsh's paper appeared after

[1] Wheeler's Report Pl. LI, Figs. 2–6.

my first exhibition of it, being an extra sheet of the May number of the *American Journal of Science and Arts.—E. D. Cope, Philadelphia, March* 20, 1878.

THE ORIGIN OF LAKES.—Prof. Ramsay, F.R.S., Director-General of the Geological Survey, gave the Monday evening lecture at the London Institution on "The Great Ice Age." He commenced with a description of a typical Swiss glacier, drawing special attention to that which is commonly called the perpetual snow line, here some 8,500 feet above the sea level, which is called perpetual rather by courtesy than as being an absolute fact. While it is the snow which furnishes the mass of the glacier, the fragments of rock carried down originate in this way: There are some steep slopes which are not covered with snow, and are exposed to the heat of the sun. The alternating heat during the day and the cold of the night cause disintegration, and masses of the rocks are broken off, which not only form the heap of rubbish called moraines, but some of which, falling through the crevasses, form the "graving tools" which score the mass of rock beneath into grooves. If we look further afield, we find glaciers in the Himalayahs, in Greenland, and in Victoria Land which make those of Switzerland appear quite insignificant. In Victoria Land the sheets of ice which float off are of enormous thickness, and indicate through what a severe glacial period the Southern Hemisphere is passing. The chief signs by which the former existence of glaciers in places where they no longer flow can be traced, are the old moraines and the scratchings on the rocks. Taking these as guides, the eye of a trained glacialist can detect with certainty the traces of long-departed glaciers in many parts of the world. The well-known examples in Wales were first mentioned, and then in succession those of Scotland and North England were described. There is evidence in Scotland that in former times the glaciers were so extensive that part flowed out through the Frith of Forth, part through the Frith of Clyde, and part over the table-land of the Lammermoor Hills. Cumberland at one time was smothered in glacier ice. The glaciation of Anglesea was the result of a different system from the glaciers of Wales, as is proved by the fact that the striations of the rocks lie in different directions. The Scandinavian mountain chain has been unmistakably moulded by glacier action, and there are abundant evidences that North America has been intensely glaciated. These facts had been noticed by many observers, but there was a point in connection with this which Prof. Ramsay said he claimed as his own idea, and that was with regard to the origin of lake basins. His belief is that in all cases they have originated from glaciers—that is, that the basins have been scooped out by glaciers. He pointed in confirmation of his position to cases in many parts of the world where there are lake basins near

mountain chains which could have furnished glaciers, and that lakes are absent in districts where there are no high chains. He did not, however, say that there were not some which had originated from other causes. The lecture was illustrated by diagrams and water-color drawings.—*London Times.*

(While glaciers have undoubtedly modified mountain valleys, which existed in mountain chains long before the glacial epoch, it is the opinion of many who have had large experience in glacial studies, that the agency of glaciers in scooping out lake-basins is much exaggerated. Many glacial lakes are due to streams being dammed by old moraines.—EDS. NATURALIST.)

A NEW FAUNA.—Prof. Cope has recently made an examination into the Permian formation of the west, of which a fragment was found by Dr. Winslow, in Illinois, a few years ago. He finds this period to have been rich in life, chiefly in *Reptilia* and *Batrachia.* Two remarkable genera of saurians have been discovered, in which the long diameters of the crowns of the teeth are transverse to the axis of the jaws. In one of these, *Diadectes* Cope, the teeth are flat, like those of the pharyngeal teeth of *Catostomidæ;* in the other, *Bolosaurus* Cope, the crowns are bulbiform with an apex on one side, and a deep notch on the other side. *Diadectes sideropelicus* and *Bolosaurus striatus* and *B. rapidens* are the known species. *Clepsydrops* has been found to have the canine and incisor teeth distinctly characterized. The ischia are immensely enlarged in an antero-posterior direction, forming a boat-shaped body. The neural spines of the lumbar and sacral regions are greatly elevated, indicating a fin like that of *Basiliscus.* Two new species are described, *C. natalis* and *C. gigas*, the latter of the size of the larger *Mammalia. Epicordylus* has vertebræ like those of *Clepsydrops*, but the neural spines are all club-shaped. The typical species is *E. erythroliticus*, which is as large as an alligator. The most remarkable form is *Empedocles*, which has a few characters which especially characterize the genera of the Dakota Cretaceous, *Camarasaurus* and *Amphicœlias.* These are the hyposphen and hypantrum articulation, and a transversely thickened neural spine. The zygapophyses are greatly elevated, and are connected with each other and the diapophyses by a wide expansion. The only species is *E. alatus*, whose vertebræ were as large as those of the alligator. These saurians have deeply biconcave and mostly notochordal vertebræ, with intercentra, and are referred to the order *Rhynchocephalia* by their describer.

Several genera and species allied to *Mastodonsaurus* were obtained. *Parioxys ferricolus* is a new form with equal external teeth like *Rhinosaurus*, but with long mandibular angles. Two other genera belong to the *Ganocephala* of Owen, but differ much from *Archegosaurus.* In *Trimerorhachis* the neurapophyses are united into a v-shaped bone with zygapophyses and no neural spine.

The centrum is represented by a cortical ossification of the chorda dorsalis on each side, while a large crescent-shaped ossification of the sheath alternates with the neural arches on the inferior side. This body is called the *intercentrum* by Prof. Cope. The basioccipital and parasphenoid bones are ossified, and the former bears a cup-shaped articulation for the first vertebra, and is fissured for the chorda. The only species is the *T. insignis.* The other genus is *Rhachitomus.* Here the centrum is replaced by the large intercentrum, and the neurapophyses bear part of the articular surface usually carried by the latter. They bear a continuous neural spine. The chorda dorsalis is much reduced by the ossification of the intercentra. The typical species was probably larger than the *Empedocles alatus,* and has been named *Rhachitomus valens.*

More than twenty species of this fauna have been determined by Prof. Cope, and mostly described in a paper read before the American Philosophical Society on March 5th.

GEOGRAPHY AND TRAVELS.

The Geographical Work of the Year.—In his annual presidential address before the American Geographical Society, Feb. 27th, Judge Daly, reviewed the geographical work of the year. He first drew attention to the confirmation by the English Arctic Expedition of the discovery by Dr. E. Bessels of the junction of two important tides in the larger part of Smith's Sound, creating the impression that a new type of tide has been ascertained, occurring every eight hours. After detailing Dr. Schliemann's discoveries, and the different national surveys, he alluded at some length to the topographical survey of New York. In pursuance of the recommendation of the society, an act was passed and an appropriation of $20,000 was voted for beginning the work. The general secretary of the society, James T. Gardner, was appointed director, and the work has now been in progress two years under his charge. The triangulation has been carried through the eastern-central part of the State, extending from the Hudson river to Utica, over an area of about 3,000 square miles, including parts of eleven counties. The work is of the highest order of accuracy. Every city, village and hamlet is thus located with absolute precision. A map has just been published, accompanying the report of the director. A comparison of this with the former maps shows that on the old map of this part of the State, the cities and villages are often misplaced more than a mile. The survey has not found a single town where it was represented to be on the old maps. During the coming season, the triangulation would be extended across the entire State.

Lieutenant Wyse, of the French navy, who conducted the expedition for ascertaining a route for a canal across the Isthmus of Darien, completed his reconnoissance during the year and has

published his preliminary report. His conclusion is that no navigable channel is possible between the Tuyra and the Atrato without locks or tunneling.

Dr. A. Le Plongeon has been engaged for some time in researches in Yucatan among the ruins of Chichen Itza, Uxinal and Aké, and those of the once famous islands of Azumel and Mujeres, and has made many interesting discoveries. He has taken many valuable photographic views of ruins, structures and hieroglyphics, and discovered a remarkable statue which was buried twenty-one feet in the ground. He also discovered some other figures in the Island of Mujeres; he thinks that relations formerly existed between the people of Yucatan and the inhabitants of the islands on the west coast of Africa, as he finds many things resembling the Guanches, the early inhabitants of the Canary Islands, whose mummies are yet found in the caves of Teneriffe, and in other islands of the group.

In South America Major D. A. Rivara and M. A. Werthemen have been exploring in the mountains of Peru, M. Weiner in Bolivia, and Signor F. P. Moreno in Patagonia. They have been measuring the heights of mountains and seeking the sources of rivers. Many interesting facts have been learned.

There have been many explorers in Asia; in Palestine, Persia, Turkestan, Thibet, China, India and Japan. Herr E. Knipping has been engaged in extensive surveys in Japan, and has completed a large map of the country, which will soon be published. He was last surveying a route from Kobi to Tokio, a distance of over 3000 miles.

Mr. Wojeikoff completed his meteorological journey round the world, during the course of which it will be remembered we had the pleasure of seeing him at one of our meetings. His last visit was to India, Java and Japan, and he made an excursion into a part of the interior of Japan never before visited by Europeans.

When I referred to Mr. Stanley in my last address, he had finished his expedition to Lake Akengara, south-west of Lake Ukerewe, and was on his way to Lake Tanganika to explore the country south of the Mwutan Nizige, and north-west of that lake, in the hope of reaching the Mombutto country at the north, so as to connect his own discoveries with those of Schweinfurth, across the equator. It will be remembered that I mentioned last year that Lieut. Cameron circumnavigated Lake Tanganika, and concluded, from his own observations, that he had discovered the outlet of the lake in the River Lukuga, flowing from it on the western side. An ordinary traveler would have been satisfied with Cameron's survey and his conclusion as to the outlet, but Stanley, in the true character of a geographical explorer, determined to go round the southern part of the lake himself, and the result was that he ascertained by a detailed survey and careful soundings that the River Lukuga, instead of flowing out of the lake, flowed into it.

After completing this work, Stanley started with a force of 140 porters for Nyangwa, the farthest northern point attained by Livingston or Cameron, carrying his boat, the Lady Alice, with him in sections. Stanley reached this place in November, 1876, after a journey of about 350 miles in forty days; in itself, a remarkable geographical feat. Those only who are acquainted with the dangers and difficulties of African exploration, know how frequently the most sagacious conclusions, founded upon what seemed to be the most trustworthy information, have not only been attended by failure, but with the most disastrous results, can fully appreciate what Stanley undertook, and the hazard he ran in determining to follow the Lualaba river in its northerly course. The river ran to the north, apparently in the direction of the sources of the Nile. He had Livingstone's conviction that it was the remote source of that river. To follow the river, however, in its northerly course, might lead him, if his theory should not be verified, into the interior of Northern Africa, where he would be, with a large body of followers, without supplies, and in a state of utter destitution. He appreciated the great risk he ran, but after fully considering it, he came to the bold determination to follow up his theory, and in this exhibited the same geographical instinct which he has referred to as such a remarkable faculty in Captain Speke, the discoverer of Lake Ukerewe. He accordingly started to follow the river to the north. He reached the Atlantic coast in August, 1877, having made a journey from Uyangwa down the river to its mouth, a distance of about 1,800 miles, passing on the way fifty-seven cataracts.

When we saw Mr. Stanley here in the society, his hair was black; it is now said to be entirely white. Of the 350 men with whom he left Zanzibar, in 1874, only 115 reached the Atlantic coast, and 60 of these, when at the journey's end, were suffering from dysentery, scurvy and dropsy. He was on the Congo from November 1, 1876, to August 11, 1877,—a period of over nine months; so that his promise to the native followers was fulfilled, that he would reach the sea before the close of the year.

It remains only to refer to the geographical knowledge which has been obtained by this remarkable exploration. The entire area drained by this great African river, Stanley computes at 860,000 square miles, 450,000 of which are taken up by the great basin and the maritime regions of the west. The source of the Congo, as now ascertained, is in the high plateau south of Lake Tanganika, in a country commonly called Beza, or Ubeza, but from Moesa Lake to the river Lualaba no European knows anything of its affluents. The Congo issues from Lake Bembo, called by Livingstone, who discovered it, Bangwelo. Descending beyond 17° E. longitude, the Congo spreads out into an enormous breadth, and then slowly contracts between hills, when it thunders down, steep after steep, for 180 miles, and then flows as the ma-

jestic and calm Lower Congo. In this 180 miles it has a fall of 585 feet. Stanley found the people in this region very friendly. It is navigable for 110 miles from its mouth to the first rapids and beyond them for 835 miles, while the great affluents he estimates which flow into it from the north and south would give 1,200 miles and perhaps more. He estimates its greatest affluent, the Ikelemba, to be over 1,000 miles in length, the Nakuta or Kwango to be over 500 miles, while there are four or five others which, from their breadth, he thinks, should be navigable for great distances. The Nile, he says, has greater length than the Congo, but the Congo could furnish water for three Niles, and it is a much more valuable river for commerce than the Nile, as the Congo has its rapids concentrated in two places, and is not, like the Nile, frequently interrupted by rapids. The upper rapids, where all navigation westward on the Upper Congo terminates, has six great falls, while the lower series has sixty-two important falls and rapids, with many minor ones. Once above the lower cataracts, he says, we have the half of Africa before us, with no interruption like the desert regions of the Nile, but one vast populous plain, no part of Africa with which he is acquainted being so thickly inhabited. The term villages, he says, can scarcely be applied, for it is a collection of dwellings, and there are towns in some places two miles long, with one or more broad streets, and rows of neat and well-built houses, superior to anything to be found in Eastern Africa.

Fault has been found with Mr. Stanley, especially in England, for the warlike contests and destruction of savage life that attended his exploration, which it has been said will make it difficult for any future explorer to follow in the same direction, and which the objectors attribute to a too ready disposition on his part to employ fire arms instead of trying conciliatory measures. He was attacked in the beginning and continued to be attacked until he came to that part of the river where natives dwelt who had intercourse with the Atlantic coast, but as he has stated, and as there is every reason to believe, he acted throughout entirely on the defensive.

In no other way would it have been been possible for him to have followed the river as he did for 1,800 miles, and none but a man of his indomitable perseverance, courage, sagacity and tact could have carried through such an exploration, which is one of the most remarkable on record. When his exploration of the Congo is taken in connection with what he did in tracing the far-distant sources of the Nile, in the river that enters at the southern part of Lake Ukerewe (Victoria Nyanza); his successful circumnavigation of that great lake; the investigation of its tributaries, and what he ascertained in respect to Lake Tanganika, both on his first and his last examinations of it, it may be truthfully said that no man has ever, in explorations upon the land, done so

much for the acquisition of geographical information. In respect to the great water system of Africa, in its connection with the mystery of the Nile and the mystery of the Congo, he has solved an enigma that has attracted the attention of the world for ages, and fixed his name in the foremost rank of geographers, explorers and travelers.—*Condensed from the New York Tribune.*

MICROSCOPY.[1]

MICROSCOPICAL SECTION, TROY SCIENTIFIC ASSOCIATION.—A regular meeting of this section was held on the evening of April 1st, Dr. R. H. Ward, chairman of the section, in the chair.

Minutes of the last regular meeting and record of the subsequent soirée were read and approved.

Dr. Ward announced an invitation from the microscopists of Indianapolis to their fellow-workers throughout the country, to attend a *National Congress of Microscopists* in that city, commencing on Wednesday the 14th of August next, and adjourning in time for members to attend the meeting of the American Association at St. Louis, one week later. The biological section of the Indianapolis Lyceum of Natural History, assisted by many influential citizens, will make ample arrangements for the comfort and economy of visitors from abroad, both in obtaining reduced rates of travel and in the most liberal entertainment while in the city. A detailed statement of the proposed work of the congress and of the facilities offered by the local management will be given to the public, within a few weeks, in the form of a circular. The committee of arrangements, consisting of Prof. E. T. Cox, chairman, Mr. E. Sharpe, Dr. Henry Jameson and Dr W. W. Butterfield, secretary, have received the individual endorsement and promise of coöperation of leading microscopists, and now formally extend an invitation to the microscopical societies and workers throughout the country, with the assurance of a successful meeting. Such a congress, with its opportunities for stimulating microscopical work, discussing questions of general importance, and cultivating personal acquaintance among fellow-workers in the science, has been under consideration for some time, and the present year is believed to be an unusually favorable opportunity for the meeting, on account of the facility with which scientists from the eastern and southern sections can visit Indianapolis on their way to St. Louis, with no additional expense and no delay save the time spent at the congress. Microscopists desiring to attend should apply to the secretary of the committee for circulars giving further information, and should send notice of any important business to be offered for consideration, and titles of papers proposed to be read, accompanied by a copy of the papers or by abstracts of the same, to the secretary of the committee at

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

least two weeks before the time of the meeting, in order that a correct programme may be prepared.

The invitation to the congress at Indianapolis was, on motion, accepted, and it was resolved that members finding themselves able to attend should give early notice to that effect to the secretary of the committee, at No. 413 N. East street, Indianapolis.

Mr. Joseph McKay gave a demonstration of Prof. H. L. Smith's method of dry mounting by means of a background of wax and a curtain-ring cell, showing the facility and elegance with which this method may be carried out.

Rev. A. B. Hervey described a *New Method of Fluid Mounting* which he had recently devised. In his study of the algæ and lichens he had been troubled, as others have been, by the difficulty of permanently mounting specimens while studying them, without waste of time or change of arrangements. Most of the methods of mounting either ruin such objects entirely or else require considerable time, care, and special appliances that are troublesome to a busy student; and therefore instructive specimens are often neglected and lost. The objects may be transferred from water to Farrant's solution of gum and glycerine and mounted without delay, but the structure is not well preserved and air bubbles are likely to be obstinately present. The objects show best in distilled water, sea water, camphor water, etc.; and to mount them instantly and with uniform success he prepares cells of the gum and glycerine solution put on by means of the turn table in the usual way. Having made cells of the required depth, and laid them aside until thoroughly dry, the inner half of the width of the cell is varnished on the turn table with gold size, which is also allowed time to dry perfectly. Objects in water are arranged and covered in these cells with ease, and are ready after lying aside for a time varying from a few minutes to a few hours, to receive a coat of gold size or other varnish, the fluid that exudes from the cell in pressing down the cover glass having dissolved enough of the gum cell to hold the cover in position. It has not been found that the cell is too much affected by the fluid; but if it should be so the cell could be made of the usual cements, insoluble in water, and then coated with a thin layer of gum.

Mr. C. E. Hanaman demonstrated the use of the Nachét camera lucida, and quoted opinions from discussions at the Queckett Club to confirm its superior facility of use as compared with the other forms of camera.

Dr. Ward presented the *New Self-centering Turn-table* recently contrived by W. H. Bulloch, of Chicago, and remarked that this table seemed to combine all the really radical improvements that have been made in the turn-table up to the present time. The early tables were more or less satisfactory varieties of the original Shadbolt form, and were arranged to be whirled in a variety of

ways; but the first fundamental improvement was the self-centering table of Dr. Matthews, which centered the slide for width only between jaws swinging on opposite posts and held it in place by means of a sliding wedge. This method is greatly simplified without at all impairing its efficiency, by discarding the wedge and jaws and centering by the posts alone, in the table contrived and now made by Mr. Zentmayer. Mr. Cox has undisputed priority in the expedient which now surpasses all others, and seems likely to continue to do so, of centering for both width and length by grasping the diagonally opposite corners of the slide between jaws that move automatically towards or from the center, after the manner of the different forms of American scroll chucks. In Mr. Cox's table, now well known, the jaws are moved by a horizontal screw, with right and left threads on the opposite ends, under the revolving plate. Mr. Kinne adopted independently, but published subsequently, the same principle, but moved the jaws by a lever instead of a screw. Mr. Bulloch's table is essentially a modification of the Cox table, but moves the jaws by a scroll screw on the surface of a revolving plate, precisely as is done in the scroll chucks of the machinists. The revolving table is made double, of two horizontal plates, the jaws sliding through the upper plate by means of a screw on the upper surface of the lower plate, thus securing a very steady as well as convenient and durable adjustment. In addition to this, the posts and clips are added after Mr. Zentmayer's method, by which the slide may be centered for width only. or under which it may be adjusted artificially by means of concentric rings as in the early forms of tables. The workmanship is good beyond comparison with anything of the kind except the one last mentioned; and the instrument, at its moderate price, can be commended as a real luxury to any one who desires a more elaborate form than that. It is one of the little things that are a great comfort.

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SCIENTIFIC NEWS.

— Recent arrivals at the Philadelphia Zoölogical Garden: 1 great-horned owl (*Bubo virginianus*), presented; 1 zebu (*Bos indicus*) ♀, India, born in the Garden; 1 crested anolis (*Anolis equestris*), and 1 tree boa (*Epicrates angulifer*), West Indies, presented; 2 Cashmere goats (*Capra hircus var.*) ♀, born in the Garden; 2 woodchucks (*Arctomys monax*), presented; 1 raccoon (*Procyon lotor*), presented; 1 common seal (*Phoca vitulina*) ♀, purchased; 1 macaque monkey (*Macacus nemestrinus*) ♀ India, born in the Garden; 3 alligators (*Alligator mississippiensis*), presented; 1 herring gull (*Larus argentatus*); 4 sirens (*Siren lacertina*), Southeastern U. S., presented; 2 spotted salamanders (*Salamandra maculosa*), Europe and North Africa, presented; 1 bactrian camel (*Camelus bactrianus*) ♂, Asia, born in the Garden.—*Arthur E. Brown, Genl. Supt., April* 1, 1878.

— It is with great sorrow that we announce the sudden death of Prof. Charles Frederic Hartt, Chief of the Brazilian Geological Commission. He died at Rio de Janeiro, March 18. His untimely death is a great calamity, as, after nearly three years of constant exploration over a large part of Brazil, he had begun to prepare for publication the results of the researches of himself and assistants, Messrs. Derby and Rathbun. He was born at Fredericton, New Brunswick, in 1840, and graduated at Acadia College at Wolfville, Nova Scotia. He was a student under Agassiz from 1862 until 1865, and during that time investigated the Devonian plant and insect beds of St. John, and made important researches in the Cambrian fossils of the Acadian series at St. John. He then accompanied Agassiz as Geologist of his journey up the Amazon and subsequently made three visits to the coast regions, and the results of his explorations are comprised in his work on "The Geology and Physical Geography of Brazil," published in 1870. Several years previous he was appointed Professor of Geology and Physical Geography at Cornell University. He made a specialty of Brazilian geology, and mastered the Portuguese language, investigated the natural history and archæology of that country, and so identified himself with its physical history that it seemed as a matter of course that the Emperor of Brazil should honor himself by appointing the young explorer Chief of the Imperial Geological Commission. This was in May, 1875; since then his studies have extended widely over the Empire, including the unraveling of the geology of the Amazon, consisting of Silurian, Devonian and Carboniferous rocks, the thorough examination of the coast and interior of the Province of Pernambuco, a reconnaissance of the diamond and gold districts of Minas Geraes, the examination of large areas in San Paulo and Santa Catharina. The survey had collected enormous quantities of fossils and zoölogical material from the Corniferous and Carboniferous formations in the Amazonian valley, large numbers of remains of vertebrates and invertebrates from Pernambuco, including many new reptilian and amphibian forms, mainly cretaceous. For the last six months but little field work had been done and publication was progressing rapidly. Prof. Hartt also made a thorough study of the coral reefs of the coast of Pernambuco, including ancient and modern forms. He also amassed many facts regarding the language, manners and customs of the Tupis, Guaranis and other Indian tribes, and Brazilian archæology.

Professor Hartt, besides being a geologist, palæontologist and zoölogist, was a capital linguist and philologist. He had powers of rapid acquisition and great versatility. He was a person of warm sympathies, and of a cheerful, light-hearted spirit that endeared him to all with whom he came in contact. To the readers of this journal, to which he often contributed on geological and

archæological subjects, his powers of exposition are well known. His death is a serious blow to American science. All will deplore his loss; his memory will be cherished by his fellow-students and associates who knew him best and appreciated his moral worth and his intellectual and scientific attainments.

— Dr. Charles Pickering died in Boston March 18. He was born in Susquehanna Co., Pennsylvania, Nov. 10, 1805. He was a graduate of Harvard, in the class of 1823, and of the Medical College in 1826. He was a member of the American Academy of Arts and Sciences, and of the American Philosophical Society; was the Naturalist of the U. S. Exploring Expedition under Commodore Wilkes in 1838–1842; practiced medicine in Philadelphia for several years, and afterwards removed to Boston. Besides his report of the Exploring Expedition he was the author of several valuable scientific publications.

The exploring expedition returned, leaving certain countries that required to be visited to complete the survey of the globe. Accordingly, after remaining a little over a year at Washington, Dr. Pickering set out alone in 1843 for Malta, Egypt, down the Red sea to Zanzibar, and thence to Bombay, returning after an absence of twenty-two months. He then prepared and published his work on The Races of Man and their Geographical Distribution.

Robert Swinhoe, well known as a writer on East Indian ornithology, etc., died in London, October 28, 1877, at the age of 41 years.

Francois Vincent Raspail, the French botanist, well known for his studies on the grasses, and his Nouveau Système de Physiologie Végétale et de Botanique, died near Paris, January 6th, aged 87 years.

John J. Monteiro, the author of Angola and the River Congo, which we noticed in the last number of this journal, lately died at Delagoa bay.

— I inadvertently, in your January number, gave credence to the statement of Pouchet, the Curator of the Museum at Rouen, in regard to certain changes alleged to have taken place in the nests of the house martin (*Chelidon urbica*); I had repeatedly seen the statement and was unaware that its correctness had ever been challenged. I learn from my friend, Prof. Newton, that there is nothing in the alleged progress in nest-building on the part of the martin whatever. The nest that is so well built is that of the sea mow (*Hirundo rustica*), while that of the martin continues unimproved. This matter was set right some years ago in the Zoölogical Record, but seems to have escaped notice, as the wonderful story of M. Pouchet still goes on its rounds unchallenged.—*T. M. Brewer.*

— Thanks to the interest taken in the young and vigorous Academy of Science at Davenport, Iowa, by one or two of the citizens and members, a new building well adapted to the wants of the Society has just been finished, one or two meetings having been held in it. The second part of its Proceedings will appear at an early date.

— Capt. Howgate's bill for establishing a Polar Colony has met with a favorable hearing by the Congressional committee, and it seems most probable that Congress will appropriate $50,000 for the undertaking, which promises so much for the advancement of Polar research.

— The third session of the Summer School of Biology will be opened at the Museum of the Peabody Academy of Science, Salem, Mass., beginning July 5th, and continuing six weeks. A lecture will be given each Monday, Tuesday, Wednesday, Thursday and Friday at 9 A. M., the remainder of the time to be given to laboratory work and demonstrations, as it is designed to make the course a practical one, so that teachers may learn the *method of study and teaching in Natural History*. During the present session special attention will be given to Entomology, the study of Spiders and Crustacea, as well as the Anatomy of Vertebrates, and the study of Animal Tissues.

Instruction in Zoology will be given by Dr. A. S. Packard, Jr., with the assistance of Messrs. Charles Sedgwick Minot, James H. Emerton, and J. S. Kingsley. Mr. Minot will lecture on Histology and on the Anatomy of Vertebrates. Mr. Emerton will lecture on Spiders, Scorpions and Mites, Mr. Kingsley on the Crustacea, and Dr. Packard will give a course of lectures on the lower animals and the Insects. Rev. Dr. Bolles will give a series of six afternoon lectures on Microscopy, at 3 P. M., beginning July 12.

For further information apply to A. S. Packard, Jr., Director, Peabody Academy of Science, Salem, Mass.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History. — March 6. Mr. S. H. Scudder made a communication on Prodryas, a new fossil butterfly from the tertiary beds of Colorado.

On March 20, Prof. A. H. Niles read some notes upon the erosive power of the glaciers and sub-glacial streams of the Alps, based on a summer's exploration. He took the view that a large part of the erosive action was carried on by the running water of the sub-glacial streams, rather than by the ice itself, which, however, accomplished the polishing and scratching. Dr. David Hunt spoke of a possible cause of prognathism.

April 3d.—Prof. B. G. Wilder exhibited living specimens of Amia, and spoke of its ærial respiration, and Mr. S. H. Scudder remarked on the early life of some tertiary insects, and particularly on the eggs of a fossil Corydalus (hellgramite).

SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS.—March. New genera of Pycnogonidæ, by E. B. Wilson. New dinosaurian reptiles, by O. C. Marsh.—April. Surface geology of south-west Pennsylvania, by J. J. Stevenson. The driftless interior of North America, by J. D. Dana. The ancient outlet of Great Salt Lake, by G. K. Gilbert. Intrusive nature of the Triassic trap-sheets of New Jersey, by I. C. Russell. Tree-like fossil plant, Glyptodendron, in the upper Silurian rocks of Ohio, by E. W. Claypole.

BULLETIN OF THE AMERICAN GEOGRAPHICAL SOCIETY, No. 5.—Modern researches in Palestine, by Rev. S. Merrill. My first trip up the Magdalena, and life in the heart of the Andes, by J. A. Bennet.

THE GEOLOGICAL MAGAZINE.—March. On the Pleistocene mammals dredged off the eastern coast, by W. Davies. Geology of the Channel Islands, by J. A. Bird. Micrasters in the English chalk, two or more species, by C. J. A. Meyer.

THE GEOGRAPHICAL MAGAZINE.—March. Mr. Stanley (a tribute to his success as a great explorer). The climate and soil of Sicily, by T. Fischer.

ARCHIV. FÜR NATURGESCHICHTE.—Heft. 2. A. W. Malin, on the migration of birds. Gurlt and Schilling give a list of animals on which parasitic insects live. Helminthological papers, by J. Ulieny and Linstow. Ichthyological notices, by Linstow. Herpetological studies, by J. v. Bedriaga.

ARBEITEN AUS DEM ZOÖLOGISCH-ZOÖTOMISCH INSTITUT IN WÜRZBURG.—Bd. iv, Heft. 1. May 20. *Lacerta lilfordi* and *L. musalis*, biological and anatomical studies, by M. Braun. Contribution to the biology of Oligochæta, by C. Semper (relates to the laws of budding and self-division in Nais, etc). Bd. iv, Heft. 2 (no date). The urogenital system of native reptiles, by M. Braun. Heft. 3, Jan. 1878. On the signification of the cuticular bristle on the adhesive pads on the soles of the Gekotidæ, by M. Braun. The genus *Cryptoniscdæ* (Liriope) by P. Fraisse.

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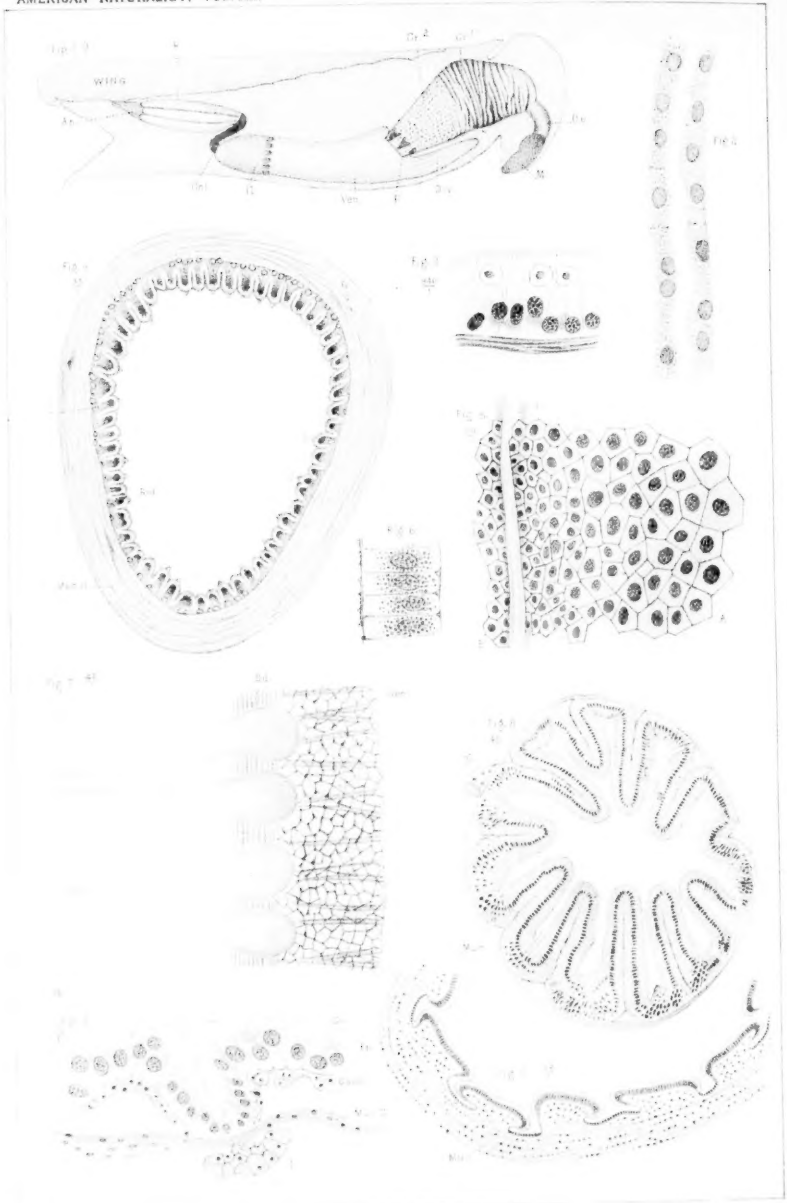

HISTOLOGY OF THE LOCUST.

EXPLANATION OF THE PLATE.

FIG. 1.—Longitudinal median section of *Caloptenus femur-rubrum*, female, to show the course and divisions of the digestive canal. *M*, mouth; *Oe*, œsophagus; Cr^1 anterior, Cr^2 posterior part of crop; *P*, proventriculus; *Div*, blind sack or diverticulum of the stomach; *Ven*, ventricle; *Il*, ileum; *col*, colon; *R*, rectum; *An*, anus.

FIG. 2.—Optical section of Malpighian tube.

FIG. 3.—Section of the epithelium of the rectum of *Caloptenus spretus*.

FIG. 4.—Transverse section of the hind part of the crop; *s s*, spines of the cuticula; *rid*, ridges; *L*, longitudinal; *muc. C*, circular muscular coat.

FIG. 5.—Epithelium of the ileal folds; *A*, middle of folds; *B*, furrow between folds; *L*, longitudinal muscular band.

FIG. 6.—Epithelial cells of the gastro-ileal valve of *Œdipoda sordida*.

FIG. 7.—Surface view of the gastro-ileal valves; *Ven*, ventricle; *Bd*, circular muscular band underneath the folds; *Il*, ileum.

FIG. 8.—Transverse section of a diverticulum. *Tr*, trachea; *muc*, circular muscular coat.

FIG. 9.—Transverse section through the furrow; *F*, between two ileal folds; *cu*, cuticula; *Ep*, epithelium; *conn*, connective tissue; *muc. C*, circular muscles; *L*, longitudinal muscular band.

FIG. 10.—Transverse section of the gastro-ileal folds of *Œdipoda sordida*: *muc*, muscular band, *Bd*, of Fig. 7.